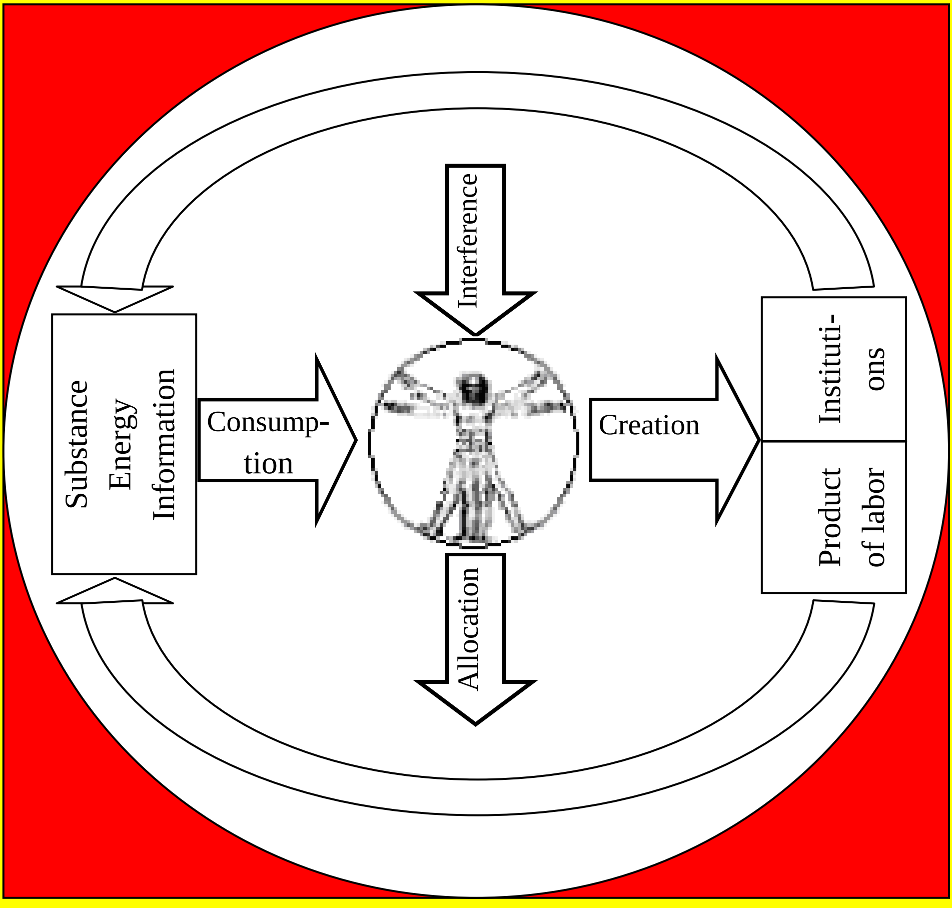
ECONOMIC METROLOGY



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ECONOMIC METROLOGY
Information essence of the method

The monograph

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The book expounds the philosophical foundations of a new scientific field related to the transferring the recognized International Metrological Measurement System to socio-economic processes. The book will be useful for university students studying the course of natural science and the qualimetry fundamentals, graduate students of philosophical and socio-economic specialties, scientists researching the problems of socio-economic measurements and a wide range of readers interested in philosophical questions of human society.

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Preface

We use the term “economic metrology” to describe the results of our research for several decades. Such a science does not exist in our society so far. However it is strongly required by many researchers and some of them were personally involved in its development (A. G. Granberg, A. E. Kogut).

As it is well known, the word *metrology* [metron/ measure + logos / notion, study] is of Greek origin and means the theory of measures, various systems of measures and weights, ways of determining their images. An applied branch of science has been formed on the grounds of the achievements of natural, engineering and social sciences, and its research object is covered by physical unit measurement, methods and means required for their integrity and accuracy. Theoretical, applied and legislative branches have emerged in the frameworks of metrology.

Economy [Greek oikonomike, which literally means “art of housekeeping”] is an aggregate of production relations of specific social structures. As claimed by C. R. McConnell and S. L. Brue – the authors of a popular textbook “Economics”: “Economics deals with the issues of management and efficient utilization of limited resources to ensure the maximum satisfaction of human material needs. Consequently, the combination of two words (“metrology” and “economy”) into one notion suggests a new research and practical course of social life related to **measurements** in national economy management.

Metrology has passed a long and difficult way of development in different countries until the international system of units was formed. Trade and later industrial development caused difficulties driven by diversification and randomness of units. Scientific achievements made it possible to put forward the idea of referring length unit and other values to permanent natural phenomena; in much the same way as it had been done before when opting for time units. It allowed to ensure the regenerability of units and gave a chance to test the viability of measures due to re-measurements. The development of metric system of measurements (which was originally thought of as a system without national features and the one that could be adopted internationally) facilitated the handling of the problem associated with the abolishment of units' diversification

France is regarded as the motherland of metrology. After the French Revolution (1789-95) the Constitutional Assembly decreed the requirement for common measures and weights following the report by Talleyrand.

The notion of the system of units was further widened by the German mathematician C. Gauss. In 1832 he proposed a method for forming combined units for a wider range of values, for magnetic quantities in particular. In 1851 W. Weber extended the system of units proposed by C. Gauss to electrical quantities. Before 1919, at the suggestion of French metrologists, International Bureau of Weights and Measures worked out the system of units based on such units as meter-kilogram-second (MKS), the one which was recommended as international. However, World War I cut this work short. It was only after World War II when the unification of units was focused at again as an issue of international concern.

In 1948 IX General Conference on Weights and Measures considered the proposal of International Union of Pure and Applied Physics related to the establishment of the international practical system of units. Moreover, the French

Government introduced the project on the international unification of units. In October 1960 XI General Conference on Weights and Measures eventually adopted the new system named “International System of Units” (SI). The adoption of International System of Units was the significant progress thereby making it possible to switch to the universal system of units, i.e. the system that covers all types of measurements.

X General Conference on Weights and Measures accepted the following resolution: to adopt at the international stage the range of basic units of the practical system of units:

a unit of length – *meter*,

a unit of mass – *kilogram,*

a unit of time – *second*,

a unit of thermodynamic temperature – *degree Kelvin,*

a unit of amount of substance – *mole*,

a unit of luminous intensity – *candela,*

and later some extra units were adopted:

a unit of plane angle – *radian*,

a unit of solid angle – *steradian*.

Relying on seven basic units, the metrology develops a large system of derived units applied in different scientific fields and in practice in such sections as:

I. Space and time.
II. Periodic and relative phenomena.
III. Mechanics.
IV. Heat.
V. Electricity and magnetism.
VI. Light and relative electromagnetic radiation.
VII. Acoustics.
VIII. Physical chemistry and molecular physics.
IX. Ionizing radiation.

However, the metric system is not a closed one, it keeps on developing occupying sections of economy and sociology which have not been subjected so far to its measurement processes. The openness of metrological system is of crucial importance in terms of integration of economy and metrology into economic metrology. We believe that **qualimetry** as a science of quantification is a liaison between economy and metrology.

In our studies we use the fact that the basic metric units are not "God given" but taken by a man (mankind) himself and then reified quantitatively for himself in the surrounding natural phenomena. So far, let us emphasize our statement without any proof that a meter is a step of a standard human body; a kilogram is a liter (dm^3) of water required for a standard human body for the daily basic metabolism; a second is one cycle of contraction of the heart muscle of a standard human body in the state of complete rest (basal metabolic state).

If these allegations are true, Protagoras, who is credited with the thesis that "man is the measure of all things", was also right. Still the life of a person can be treated with a wide variety of aspects: biological, economic, social, etc. "In the real world there are only three types of "products": substance, energy and information" (V. A. Trapeznikov). A living organism can give substance to the external environment as a result of metabolism based on the law of conservation and transformation of mass of substances. A living organism generates energy continuously, and muscular energy is very important for animals because it provides them with food and preserves their life. The most valuable is managing the impact on the environment, which a person deliberately performs generating necessary information for this purpose.

We consider all the phenomena of nature and society as manifestations of the three basic laws:

substance: law of transformation and conservation of mass of substances;

energy: law of transformation and conservation of energy;

information: law of transformation and accumulation of information.

Every single conversion process is the unity and simultaneity of manifestation of previously mentioned laws.

The comparison of basic units with the manifestations of the mentioned fundamental laws claims that the metric system should be supplemented by the **information measurement** units in terms of basic units and by the whole system of economic and social units through it in terms of the sections of derived units. It is discussed in this book.

Human relations in a society are enmeshed by money “octopus”. “Money bewitches people. Because of money, people suffer and **work** for them. They come up with the most ingenious ways to get it and the cleverest ways to spend it”. People are trying to understand the nature of money and turn to economic sciences with the help of which it appears that money is a multifunctional measuring instrument of social relations and, in particular, a means of circulation, a measure of value, a store of value, a means of payment.

In social phenomena and processes there has been a concept and actual functioning of money for thousands of years. “No one dares to, and shall not doubt, – says a faithful disciple of lawyers, Philippe of Valois in a decree of 1346, “only we and our royal majesty has the right of ... coinage, supplying money and any instructions regarding the coin,the right to let the money in circulation, and at the price we want and consider for the good”.

The publisher of the world famous guide Hutte in 1936 informed that the value expressed in rubles comes from the fact that 1 ruble is an equivalent to 0,774234 grams of pure gold. But then he warned that in many countries (e.g., England, USA, Sweden, and others) the previously existed exchange of treasury and bank notes for gold had been closed, and therefore their value was subject to significant fluctuations, and the tables relevant for more or less long period of time cannot be made in respect of such currencies. “The rate exchange value of these currencies, – concludes the publisher, – has to be found out from the newspapers”. And so the gold standard disappeared from the world stage after the Great Depression of 1929-32. And, as the authors of the famous textbook “Economics” contend: “On August 15, 1971 President R. Nixon suspended the convertibility of US dollar into gold”. Commission for Gold, set up by R. Reagan in 1981, did not recommend to return to the gold standard.

At the beginning of “perestroika”, when the country – the Soviet Union, still convulsively thrived, a number of international organizations represented by the Fart Fund decided to hold an international contest for the best project of Soviet ruble conversion among stable international currencies. As it was clear from the results, quite a large number of experts (more than 600 bids) took part in the contest. We were also among the contest participants and had our own proposals to change the monetary system based on labor measures. After considering the contest results, 5 prizes were awarded, but we got only a diploma. The prizes were given out, and probably materialized by the winners for their personal purposes. However, it was sad that the very object of conversion – Soviet ruble – disappeared from the world stage. Did the organizers expect such an outcome of the contest?

The successors of Soviet ruble became a “big brother”– Russian ruble with biceps bird of prey and fourteen CIS “sovereign independent younger brothers” of minted birds, animals and personalities. Was the situation in Earth noosphere improved after that? Modern circumstances and an endless series of tensions in the world create more pessimistic people.

Not so long ago (in 1993) Margaret Kennedy published a brochure entitled “Money without interest and inflation. How to create a medium of exchange useful for everybody?” She appeals to readers with a call to participate in changing the global monetary system. But how can the broad mass of people manifest itself in such a confusing system, which is the percentage current monetary system? She writes: “If we accept the existence of public institutions, which by their nature are directed against these objectives, the social justice, environmental survival and social freedom are under threat”.

A practical suggestion by the author carries some shade of hypotheses, but they excite the mind, force everybody to leave his/her own little world, the vicious circle of “compound interest” on investment and look at the problem from the standpoint of the whole humanity based on the interests of the entire noosphere of Earth, as Academician V. I. Vernadsky would say.

The historical fact described by M. Kennedy sounds very obliging. We will give it in full. In the Weimar Republic (1924-1933) after the hyperinflation of 1923, in 1924 Reichsmark was introduced, which meant a return to the gold standard. After “Black Friday” in 1929 and the economic crisis which started after that, Reichsbank was forced to return a part of its gold reserve taken in credit in the United States. As after that the circulation money supply could not be secured by gold in the required amount any more, Schacht, being at that time President of Reichsbank, began to reduce gradually the amount of money in circulation. The ensuing shortage of money led to higher interest rates, which was followed by the decrease in investment business, bankruptcy of companies, rising unemployment, and there appeared a good breeding ground for radicalism that eventually brought Hitler to power. Thus, the monetary policy became a prerequisite for the victory of Nazis.

Silvio Gesell foresaw such course of events. Already in 1918, shortly after the end of World War I when everyone was talking about peace and numerous organizations advocating peace were appearing, he wrote to the publisher of Berlin newspaper "Zeitung am Mittag" the following letter: "In spite of the fact that the nations give sacred oath to condemn war at all times, despite the call of millions: "No war!", in spite of all hopes for the better future, I have to say: **If the current monetary system saves the percentage economy, I will dare to claim today that within 25 years we will face a new, even more destructive war** (emphasized by Yu. Per). I see the course of events very clearly. The current level of technology will allow the economy to reach the highest efficiency very rapidly. Despite the severe damage during the war, there will be a rapid formation of capital and when it is in plentiful supply, the interest will be reduced. Then money will be withdrawn from circulation. It will lead to the reduction in industrial production, the streets will be full of the army of the unemployed... The discontented masses of people will reveal wild, revolutionary insights, poisonous sprouts of supernationalism will appear. No country will be able to understand the other, and it will result only in a war".

The greatest obstacle to the monetary system transformation is the fact that very few understand the problem, and even fewer know that there is a solution (but they do not want to realize it).

Deep inflation processes in transition economy clearly and tangibly demonstrate the instability of the whole monetary system and further urgent necessity to differentiate the functions of money and their units. First of all, the money currently seeks another unit distinguished from the ruble (the kopeck has already gone) as **a measure of cost.**

Some legal acts and norms (decrees, regulations, directives, decisions) appeared as a result of inflation and issued by administrative organs of various hierarchical levels during the past years amuse thinking people and impress interested ones. For example, a trolleybus passenger is imposed “a punishment” for a possible “crime”: “The fine of 0,1 of the minimum wage for a free ride”. If there is one-tenth of the minimum wage, there must be the whole unit – 1 minimum wage. But what measure is it? What social phenomena can and should it measure?

The minimum payment for the work performed (minimum wage) is set by the state bodies in the respective terms of money (rubles, dollars, marks, etc.). However, the very concept of value is something objective, physiologically vital activity of the phenomenon. Viewed in this way, the introduction of a new official means of payment of fines and other services in the form of the minimum wage is very symptomatic. At present (March, 1996) one minimum wage is 76,000 rubles a month, in the very recent past it was 39,000 rubles a month. Thus, the minimum wage is a kind of constant measure of living conditions and it constantly changes its ruble equivalent. If we convert a monthly minimum wage into a daily minimum wage, we will get:

76,000 / 30 = 2,533 rubles per day;

2,533 / 24 = 105,56 rubles per hour;

105,56 / 60 = 1,76 rubles per minute.

Surprisingly, but this value is the same as that from the standpoint of modern labor physiology, a person with a healthy body and able to work requires minimum amount of nutritional substances (about 1,8 kcal/min) for metabolism. Thus, a fixed minimum wage reflected a physiological minimum of energy consumption in the human body during the transition from “no work” (basic metabolism) to “work” (to suitable behavior of an unemployed about getting a minimum wage). Moreover, the minimum wage acts as the measure of labor product set according to their ability to replenish physiological energy losses in a human body.

Perhaps, this fact is a kind of confirmation of Karl Marx’s predictions that “only on the world market money fully acts as a commodity, the natural form of which is the social form of human labor in abstracto. The process of its existence becomes adequate to its concept” [Marx K. Works. Coll. V.23. Capital. V. 1, Chapter “World money”].

Much is said about social justice in the period of structural adjustment. None of the modem politicians will fail to say that he is committed to the principle of fairness. However, as soon as it becomes necessary to solve problems related to justice more specifically, there are serious difficulties in the theoretical study and practical implementation of justice.

When you ask the question: “Why did the Soviet Union fail to build socialism?” Instead of a clear answer another question comes up: “Was justice put right in the Soviet Union?” Justice in itself means the relationship between people with the “right to know”, i.e. on the basis of law. According to the Marxist theory it is known that “by its very nature the right can be exercised only in the application of an equal measure" and generalizes the meaning of the law-governed state that "the right of manufacturers is **proportional** to the labor they produce, ... the equality means that measurement is made by equal measure – labor, ... but for labor to serve as a measure it must be determined by duration or intensity, otherwise it would cease to be a measure" [Marx K., Engels F. V.19. P. 18].

Thus, we face a major problem – the definition of labor measure, measurement of its quantity and quality. Without solving this basic problem the meaning of law-governed state is lost, the slogan "To each according to his work" hangs in the air, justice, no matter how much we speak about it, remains a wishful thinking. But where is the key to solving the problem? It is in the same Marxist logic of **labor measure**, which can be legally implemented on the basis of metrology research of physical and informative and psychological manifestations of human labor processes. Our further research is dedicated to this problem. The essence of this research is described in our earlier works and, in particular, in the journal "The Economist", 1991, No 3.

Politicians, economists and lawyers are trying to see justice in the quantitative monetary manipulations, both with respect to the individual and between different parts of the state and between different states. But we have already seen from the history the consequences of resolving the issues of justice on the basis of theory and practice of mercantilism. Fair social relations can be based on **the system of measures** of economic metrology where the central position is occupied by **the labor measure, measure of consumption, measure of fair distribution and exchange.** However, there is such a comprehensive notion as **cost**, which is interpreted differently by researchers in economics. We proceed from the following definition: “Cost is the relation of production costs to utility” [Marx K., Engels F. Coll. V.1. Outlines of the criticism of political economy]. In our economic metrology studies the important place is given to the utility measurement on the basis of qualimetric measures of products and measures of living and past labor. Through them we come to the cost measure and quantification of **monetary measure** of cost.

To prove our points of view on the stated problems of economic measures we needed to do multi-disciplinary research of a wide range of physical, technical, chemical, biological, labor, qualimetric, economic and social measurement procedures in public life. We intend to present our views in the following consequence.

All the range of problems is called “Economic metrology (Justice measure search)”.

Part I. Philosophy of everyday life.

Part II. Human society as a cybernetic system.

Part III. Labor process.

Part IV. Labor qualimetry.

Part V. Product qualimetry.

Part VI. Production qualimetry.

Part VII. Cost economy. Or why socialism failed?

Part VIII. Entrepreneurial qualimetry.

Part IX. Economic metrology.

Part X. Social qualimetry.

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And now about the features of our work. It is mainly in the form of compilation. In Part 1 the author got the following results of research:

– representation of the life development stages on Earth in the form of step functions of nooevolutional process;

– general concept of economic metrology;

– suggesting the idea of distribution of metrology principles onto economic and social values;

– development of qualimetry principles as the binding system of physical, technical, chemical and biological measurement units with the system of economic and social measures;

– formulation of the law of information transformation and accumulation;

– analysis of the formation principles of information concept as the reflected complexity;

– proposal for introducing the notion of “information quantum” into scientific use based on the own interpretation of “the second remarkable limit”;

– substantiation of the complexity quantitative measure.

The work compilation nature is in the fact that in order to substantiate the proposed ideas we use works of scientists and publicists to the extent necessary for us “to construct the architectural structure”. So, we use the letters of Russian, Greek and Latin alphabets, words – from the Russian language dictionary and dictionary of foreign words, formulas – from reference-books in mathematics and physics, we borrowed individual “mind-bricks”, “mind-blocks”, “mind-panels” from different authors, often without making changes in their style – only for them to serve well in the structure we called “Economic metrology”. Many thanks to everybody whose thoughts and words have served as decent “building material”.

Yu. Per.

1
Evolution of life

"All the energy, acting on Earth right now, is the converted solar heat" [Engels F., Dialectics of nature. Moscow: Publishing house of political literature, 1965. P.214]. But the question arises: "From what point should we begin to consider the evolutionary transformation of the solar heat?" It seems natural that the beginning should be the emergence of the hypothesis of Earth origin.

HYPOTHESIS OF THE ORIGIN: KANT, COPERNICUS, PTOLEMY

The exact representation of Universe, its evolution and development of the mankind, as well as the reflection of this evolution in the minds of people, can be acquired only dialectically, with constant attention to the general interaction between appearance and disappearance, between progressive and regressive changes. Kant began his scientific career by converting Newton's solar system – eternal and unchangeable, after having been given the once famous initial impulse, – into the historical process, into the process of the origin of Sun and all the planets from the rotating nebulous mass. At the same time, he came to the conclusion that the origin of the solar system assumes its future inevitable death. Half a century later, his ideas were mathematically substantiated by Laplace, and another half a century later the spectroscope proved the existence of hot gas masses of various concentration degrees in the outer space.

Kantian theory of the origin of all the present celestial bodies from the rotating nebular masses was the greatest achievement in astronomy since Copernicus. Copernican solar system had been the hypothesis for three hundred years, highly probable, but still the hypothesis. When Le Verrier not only proved that there must be another, unknown until now, planet on the basis of this system data, but also calculated the position occupied by it in the outer space, and when Galle really found this planet, Copernicus system was proved.

It is known that Latin word "evolution" means one of the forms of motion in nature and society – continuous, constant quantitative change, as opposed to revolution: evolution and revolution are two essential forms of movement and development – evolution prepares revolution and creates the ground for it, and revolution crests evolution and contributes to its further development opening up new opportunities of evolution.

Contrasting "the celestial world" to "the earthly world", theologians asserted that everything is changeable on Earth, sooner or later comes to an end, while everything is permanent and eternal in the heaven. But where is the eternity and permanence of bodies of "the heavenly world"? The natural science proved that the system of celestial bodies, which is called the solar system, has not always been the same as now. It has its history. The stars also don not remain unchanged. Many of them flicker. The entire star systems appear and disappear. The perpetual motion and change are inherent for everything, and there is no special world that does not obey this law of genesis. However, where some forms of matter disappear, new forms, starting their own history, inevitably appear.

None of the smallest particles of the matter disappears without a trace and appears out of nothing: the matter is only converted from one form into another, never losing its basic properties. If, for example, a material object with a certain mass disappears, then definitely one or more other material bodies with the mass equaled to the mass of the disappeared body appear. In all conversion processes of atoms the total electric charge remains unchanged. The eternity of matter is manifested in this and other similar laws of nature.

Nothing can convey any movement to a material body, even the smallest one, except for the real impact of some other material body, conveying, entirely or partly, its own motion. Due to this law, all processes are interconnected to form a single circuit, in which there is and can be nothing that would not have been generated by matter. Nowhere, in any phenomena of nature and society, there are and can be actions emanated from a mysterious "non-material world" and testifying its existence. Everything has its natural causes rooted in different material bodies, their actions and properties. Science explains the material world from itself and needs no representations of any out-of-nature supernatural essences.

So, Earth once did not exist, but it appeared in the point of electromagnetic field of Sun and gravitational field of Universe, where is the center of its rotation around its axis. It is very difficult to imagine and understand Earth rotation around its axis and its rotation around Sun. How much better by Ptolemy: Earth is immobile, Sun, Moon, the stars – everything rotates around Earth. No dispute with men in the street: you got up in the morning – Sun was in the east, you looked in the evening – Sun was in the west, so Sun turned around Earth for a half-circle. The same for Moon and other planets. Everything was created by God. Read and listen to the Old and New Testaments and calm down – in fact, the visibility of phenomena proves the truth of Creator. And if you want a deeper understanding, study the mathematical manipulations and descriptions of Claudius Ptolemy about the geocentric system.

It is difficult, oh, how complicated to understand Copernicus! The essence “flows away” from the visibility of phenomena. But Earth had the origin, didn’t it?

ORIGIN AND CHEMICAL EVOLUTION OF EARTH

Previously we found that **all creations are the processes of substance, energy and information conversion**. Everything that happens on Earth is possible and appears due to the influence of Sun. There would be no Earth without Sun. Therefore, this is the starting point, from the position of which it is possible to tentatively express the idea that Earth was generated by Sun.

Let us speculate on the subject together with G. V. Voitkevich, the author of the book “Origin and chemical evolution of Earth” [Voitkevich G. V. Origin and evolution of Earth. / 2nd edition. Series “Earth and Universe”. Moscow: Nauka, 1983. 168 p.] The intensive investigation of the planets of the solar system by means of automatic devices and in-depth study of the materials in the past decade have made it possible to throw new light on the early stages of Earth development. Achievements in geochemistry and cosmochemistry lead to the convergence of their problems and essentially confirm the basic idea that the process of our planet origin was primarily associated with the physical and chemical processes in the primary nebula, which were rather complex and proceeded with different intensity. In addition, the further process of isotopic cosmochemistry indicates that the early history of the solar system was connected with the history of not only the now-existing chemical elements, but extinct, including isotopes of transuranic elements. The origin and chemical evolution of Earth – one of the stages of this history.

Based on cosmochemical, geochemical and geophysical data acquired in recent years, it is possible to find some controversial issues of the origin of Earth and its chemical changes in the course of the long geological history. According to the geochemical properties of the elements we can judge about the chemical evolution of the planets, by the value of radioactivity – to study the thermal history of Earth. Recent data on the distribution of elements and their isotopes in the investigated cosmic objects and material of Earth suggests the genetic unity – kindred of all substance of the solar system.

Taking into account the abundance of elements and basic forms of their location in the solar system in a wide range of temperatures, the most common elements can be divided into the rock-forming (forming solids), chemically active volatiles and inert gases. Rock-forming elements compose the bulk of rock bodies in the solar system: Earth crust, moon rocks, meteorites, and the bulk of Earth-like planets. Volatile elements are the characteristic elements of the solar substance. Inert gases do not enter into chemical compounds with other elements and remain in the gaseous state even at very low space temperatures within the solar system. Sun is a gaseous ball with the surface temperature of 6000° K, which increases towards the center. This temperature is above the boiling point of any material. Therefore, the substance of Sun – hot ionized gas. Most of the mass of Sun is made of hydrogen and helium. Therefore, we can consider Sun itself as a hot hydrogen-helium gaseous sphere, slightly diluted with the admixture of remaining chemical elements.

We can assume that at one of the moments of cosmic history, the accumulation of substance on Sun led to such its density, which gave rise to the critical value of the potential energy in the substance unit. Beyond a certain concentration of potential energy there must be the explosion of Sun substance that has its own electromagnetic field subject to the laws of the gravitational field of Universe. Being outside its body, the gaseous substance of Sun, at the time of release, falls immediately to the "embrace" of the electromagnetic field of Sun. Due to the huge kinetic energy at the initial moment, the substance ejected by Sun had to move up to the moment when its speed was balanced with the resistance of the electromagnetic field of Sun.

The substance ejected by Sun consisted of individual elementary particles, not interacting with each other. But the lack of interaction is only a passing moment of time. By virtue of the laws of electromagnetic induction, each particle of the substance ejected by Sun, instantly acquires its own electromagnetic field, peculiar to its own mass and substance density. But because each particle (without the exception of at least one) acquires the electromagnetic field with this particle characteristic potential, then the complex interaction between the particles and all the particles with the electromagnetic field of Sun starts within the electromagnetic field of Sun. Everything generated by the interaction of electromagnetic fields occurs under the "watchful" attention and interaction of the gravitational field of Universe.

The kinetic movement of electromagnetically interconnected particles of the substance ejected by Sun lasts until the electromagnetic field of Sun "slows down" the escape energy from it. Accordingly, for the mass of electromagnetically united ejected particles of the substance there can be such a point in the electromagnetic field of Sun, where the kinetic energy of ejection will recompose and the new movement of the body interacting with the electromagnetic field of Sun will start.

Perhaps, this is how Earth was originated with its rotation orbit around Sun and its own axis of rotation. The processes of substance transformation on Earth from now on will flow under the influence of solar energy obeying the gravitation laws.

So, we tend to believe the hypothesis that Sun is the “parent” of Earth and everything that is developing on it and in it – all this is the beneficial result of the solar energy.

The cooling down of the gaseous nebulosity resulted in the substance condensation into liquid and solid bodies, first, drops and then the particles as solidified drops. The laws of chemical thermodynamics allowed calculating that refractory metals, in particular, iron drops and subsequently silicates were the first that condensed from the composition of the solar substances at temperatures $1800\text{-}1000^0$ K. Then other less common metals and their compounds with sulfur and oxygen condensed at temperatures $1000\text{-}400^0$ K.

The course of chemical processes and condensation is determined by the temperature drop in different parts of the primary nebula, as well as the fluctuations of carbon to oxygen ratio, which led to its chemical heterogeneity. Near Sun the cooling of the primary gas was slower and further away from it – more quickly. Therefore, Earth-like planets located closer to Sun originated by thickening the most high-temperature fraction with the increased content of metallic iron.

After the formation of Earth, the interaction of electromagnetic fields of Sun and Earth and gravitational forces compacted Earth substance to such a state that original solid bodies with the energy excess per unit mass – radioactive substances and their specific types were formed. The rapid heating of Earth started at temperatures below the melting point of its material under the action of strong radioactivity. It is associated with the primary chemical differentiation that led to the formation of the planet central core.

The further differentiation of Earth substance proceeded mainly in the upper regions of the mantle and on the surface during the century-long circulation of the crust material under the influence of solar energy and electromagnetic internal forces of the planet at the chemical, mechanical and radioactive interactions with the ocean and atmosphere. The emergence of tiny life forms (viruses, bacteria, etc.) is directly related to the radiation exposures in the inorganic world. The origin of life at the beginning of Earth development resulted in the formation of biosphere, hydrosphere, atmosphere and upper layers of the lithosphere.

Life quickly gained the space of upper geospheres, involving more masses of the substance into the century-like biogeochemical circulation, which substantially affected the evolution of the sedimentary shell of Earth crust. Originally, Earth surface was deprived of free oxygen, and Sun ultraviolet radiation could penetrate into the primary ocean to the depth of 10 meters. The lighted surface layers of the seas were the places where the conditions for the development of living matter that gave origin to photosynthetic organisms emerged. Single-celled photosynthetic organisms – blue-green algae or their ancestors could originate where they were protected from harmful ultraviolet radiation of Sun, i.e. deeper than 10 m.

Thus, the conditions necessary for the evolution of single-celled photosynthetic autotrophic organisms were the most favorable in that region of the sea where the visible sunlight penetrated, where UV radiation was absorbed. The evolution of these ancient organisms proceeded at their constant density, as the cell which became heavier, lowered below the lighting zone, and if it was light, then it floated up being subjected to the destructive action of ultraviolet radiation.

LIVING SUBSTANCE

The emergence and development of photosynthetic organisms in the lighted area of the sea led to the water decomposition and emergence of free oxygen that caused the development of the biosphere of oxidative character. Carbon dioxide was almost completely removed from the atmosphere by photosynthesis and carbonate formation.

The emergence of free oxygen in the atmosphere resulted in the formation of the ozone screen preventing the destructive effects of ultraviolet radiation on organisms. It created the possibility of sharp dispersal of organisms in space and life origination on land.

The world of animals consuming plants emerged as a build-up above the photosynthesis of plant organisms under the conditions of Earth oxidizing atmosphere. Animals lost the ability of natural synthesis of organic compounds (amino acids, etc.) important for their life, consuming them from the plant world. At the same time, the life of animals was associated with the oxidation processes by breathing and fixing oxygen in blood pigments. Animals were able to develop their functions within the cryptozoic interval of Earth history, to actively move in space and conquer new habitats. However, for a long time the evolution of animals had been taking place in the sea – in the sea region saturated with oxygen. At that time, animals had bodies of soft tissue without solid skeletons.

Evolution of skeletons was greatly delayed because solid skeletons made the bodies heavier, and they sank below the oxygen layer into the area with no conditions for life. Therefore, solid skeletons could only originate in those organisms, which acquired a swimming apparatus and were able to swim on their own, or move along the bottom in the area of sea coasts.

After multicellular organisms acquired solid skeletons, carbonate rocks began to be formed mainly by biogenic way in the course of further geological history. The surface layers of the ocean for a long time had been the main place where the intensive circulation of carbon, hydrogen, oxygen and other biophilic elements took place. Only with the emergence of land vegetation the role of the ocean surface in the production of free oxygen decreased, giving way to the surface of the continents.

The world of animals exists only due to the vegetational living substance and cannot exist separately. And if green plants died, it would inevitably share their fate. It is one indivisible phenomenon of nature. The world of animals does not represent life by itself. In its physiological machine an animal body dissipates the energy accumulated by green chlorophyll-containing organisms. But the totality of animals, especially the civilized humanity, apparently corresponds to the same energy manifestations that are so characteristic of green plants. Taken together, animals and plants, the whole living world are a natural phenomenon, contrary to Carnot's principle in its usual form by its effect in the biosphere. Usually **the effective energy increases** in the earth crust as a result of life and its manifestations.

If we look at the whole biogeochemical work produced by living organisms, inseparable from them and produced by them due to the energy they captured, we see the creation in this way the complicated, single complex of self-sufficient organisms, the active energy of which at one and the same source – continuous but not increasing energy of Sun – increases. This increase in active energy affects at least the increased awareness and the growing influence of the biosphere in geochemical processes of the single complex of life. One consciousness, slowly developing in geological time, of such a geological force, which is the civilized humanity characteristic of our Cenozoic era, clearly demonstrates it.

The life impact on the biosphere increases at the uniform inflow of the efficient (solar) energy. **A living substance accumulates and creates it, but does not dissipate**.

In connection with life development in the biosphere we should point out an important geochemical equilibrium associated with the geochemical carbon balance, the essence of which is not sufficiently clarified yet and that is crucial. Even in 1934 V. I. Vernadsky wrote that a simple numerical ratio, still unknown to us, between the amount of free oxygen on our planet, its biosphere and mass of coals, bitumen, oils, carbonates in it should exist over the geological time.

The quantitative estimates of this ratio were taken by A. B. Ronov not long ago who took into account the limited reserve of carbon dioxide. Free carbon dioxide as the main food source of all living substance was continuously replenished by volcanic processes. But with the termination of these processes related to the exhaustion of internal energy sources, the bringing of carbon dioxide to the surface also stopped. As a result, the death of the biosphere and cessation of life should occur, as its resources of deep carbon dioxide feeding it will disappear. Free oxygen, not replenished by photosynthesis, will be gradually consumed for the oxidation processes.

As suggested by A. B. Ronov, it is unlikely that life can shift to the closed cycle, as with a limited reserve of carbon in the system “atmosphere-ocean-living substance” and its inevitable losses during the carbonate sedimentation reserves of *C* will be also exhausted. The author comes to the general conclusion, which is formulated by him as the geochemical principle of life preservation: “Life on Earth and other planets, all other things being equal, is possible only as long as these planets are active and there is an exchange of energy and substance between their depth and surface. Life will inevitably end with the energy death of the planets”.

As for Earth, taking into account the future prospects of the humanity development, we have to be afraid of this conclusion. Mastering huge sources of nuclear energy will release masses of carbon dioxide necessary for life concentrated in carbonate rocks of the earth crust.

The conquest of nature, rational and harmonious use of its resources are inconceivable without studying the circulation of all chemical elements in Earth biosphere. But this circulation produced by the energy of Sun and internal atomic energy of radioactive decay has an unusually long history. The determination of physical and chemical equilibriums in the biosphere of Earth and depths is continuously violated by powerful energy impulses coming from the depths of space and the planet.

SCHEME OF STEPPED EVOLUTIONARY PROCESSES ON EARTH

The evolutionary relationships indicated here can be presented in the form of the stepped pattern.

The evolutionary process is a process in which the action of the law of transition of quantitative concentrations into a new qualitative state is clearly demonstrated. It is vividly proved by the change in the quality of chemical elements depending on increased substance density (from helium-hydrogen to uranium). This law can be graphically represented in the form of the stepped density increase depending on the interaction time of electromagnetic fields in the gravitational field. An elementary cycle is the interaction of Earth rotation around Sun, i.e. the earth year.

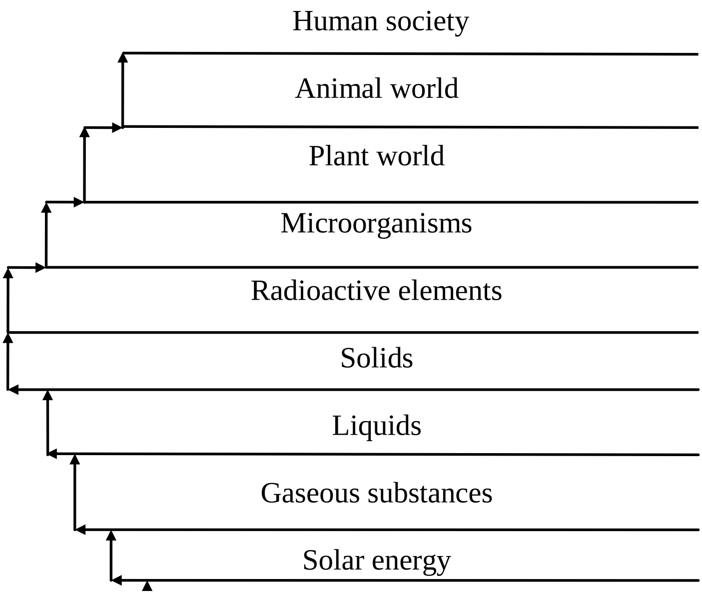


Fig. 1.1. Scheme of the stepped evolutionary process on Earth

The arrows in the diagram (Fig. 1.1) show the direction of the stepped evolutionary process.

By way of hypothesis, we propose the formula of the relationship of evolution time of inorganic world and the density of its substance:

$$T = e^{t_{He} \cdot \rho_i} \quad \text{or} \quad \rho_i = \frac{\ln T}{\rho_{He}},$$

where T – duration of evolution, years;

t_{He} – time of helium density;

ρ_i – density of the considered chemical element;

ρ_{He} – helium density.

Inorganic world. The world of chemical elements and their compounds. The totality of the elements in the generalized form is presented in the periodic system of D. I. Mendeleev. The density, characterizing the ratio of mass to its volume can be accepted as a quantitative criterion of the evolutionary process of chemical elements. In this sense, hydrogen is the lightest and uranium with the density of 19,12 g/cm^3 and platinum with the density of 21,45 g/cm^3 are the heaviest elements. Outside uranium chemical elements have an even higher density, but they decay rapidly and spontaneously into isotopes of other substances accompanied by the emission of elementary particles or nuclei (e.g., helium).

Organic world. In the organic world the stepped function does not depend on a substance density. Here, the main indicator of evolutionary development is the ratio of free energy of the organism to its mass (by V. I. Vernadsky). Currently, the available data do not allow us to represent another evolution of the living substance in the form of a hypothetical formula.

2
Noosphere – sphere of labor

"Man, as he is observed in nature, like all living organisms, like every living substance is a certain function of the biosphere in its particular space-time" [Vernadsky V. I. Philosophical thoughts of naturalist. Moscow: Nauka, 1988. P. 46].

Man, like all living things, is not self-sufficient natural object, independent of the environment. The inseparability of a living organism with the environment is undoubtful for a modern naturalist. A biogeochemist takes it and tries to accurately and perhaps deeply understand, express and establish this functional dependence. Every living organism in the biosphere, a natural object, is a living natural body. A living substance of the biosphere is the totality of living organisms.

A living substance, as well as the entire biosphere, has its special organization and can be regarded as a naturally expressed function of the biosphere. There is a continuous exchange of material and energy between the inert lifeless (inorganic) part of Earth, between its inert natural bodies and living substances inhabiting it, which is materially expressed in the motion of atoms induced by the living substance. This exchange in the course of time is expressed by the equilibrium naturally changing, continuously striving for stability. It penetrates into the entire biosphere, and this biogenic current of atoms largely creates it. Thus, the biosphere is inseparably linked throughout the whole geologic time with the living substance inhabiting it.

NEW GEOLOGICAL FORCE

In the course of geological time we observe the process of continuous expansion of the biosphere boundaries – its population with a living substance. The biosphere organization – organization of a living substance – should be regarded as the equilibrium in single cycles and, at the same time, as the development process in the course of geological time.

The evolutionary process of living substances continuously spans the entire biosphere throughout the whole geological time, so that the evolution process – change – is transferred to the natural bioinert and biogenic bodies, playing the major role in the biosphere, to soils, to surface and underground waters (seas, lakes, rivers, etc.), to coals, bitumen, limestone, organore, etc. The evolution of species passes into the biosphere evolution. At the same time, the evolutionary process obtains a particular geological significance due to the fact that it created **a new geological force – the scientific thought of social mankind.**

We are just going through its clear entry into the geological history of the planet. In the last millenniums, there was an intensive growth of influence of one species of living substance – civilized mankind – on the biosphere change. Under the influence of humanity and scientific thought the biosphere transits to a new state – **the noosphere**.

Humanity is encompassing the entire planet in a natural movement that has lasted with the ever-increasing pace for several billion years or so, is distinguishing itself, is being separated from the other living organisms as a new unprecedented **geological force**. At a rate, comparable with the reproduction, expressed by the geometric progression over time, the ever-growing set of inert natural bodies new for the biosphere and new large natural phenomena is created in it.

Before our eyes, the biosphere is rapidly changing. And there can hardly be any doubt that its restructuring by the scientific thought through the organized human labor manifested in this way is not an accidental phenomenon, which depends on a human will, but it is a spontaneous **natural process**, whose roots lie deeply and were prepared by the evolutionary process, which lasted for hundreds of millions of years.

Man must understand how only the scientific rather than philosophical or religious concept of the world will overwhelm him, that he is not a random freely acting natural phenomenon, independent of the environment. He is the inevitable manifestation of the large natural process, having naturally lasted for at least two billion years.

Currently, under the influence of the surrounding horrors of life, along with an unprecedented blossom of the scientific thought, we have to hear about the approach of barbarism, collapse of civilization, self-destruction of the humanity. These sentiments and judgments seem to me the result of insufficient penetration into the environment. The scientific thought has not yet entered our life; philosophical and religious skills not satisfying the realities of today's knowledge are still persisting. The scientific knowledge, which manifests itself as a geological force creating the noosphere, cannot lead to the results contrary to the geological process whose creation it is. This is not an accidental phenomenon – its roots are very deep. This process is connected with the creation of human brain [Vernadsky V. I. Philosophical thoughts of naturalist. Moscow: Nauka, 1988. P. 25-28].

NOOSPHERE AS THE SPHERE OF LABOR

The main impact of human thoughts as a geological factor is revealed in its scientific manifestation: it mainly constructs and directs the technical work of the mankind. Man as a constituent element of humanity thought scientifically and changed the biosphere with labor, adapted it to himself and created conditions for the manifestation of biogeochemical energy of propagation inherent by him. The population of the entire planet was completed by the beginning of XX century. We can assume that by the first quarter of the century it became the fact and it strengthens more and more every year. It was only possible due to the sharp changes in the living conditions associated with the new ideology, with the sharp changes in the tasks of state life, with the growth of scientific methods and instruments.

After many hundreds of thousands of years the coverage of the entire biosphere surface was completed by the single social species of the animal kingdom – man. There is no corner in the world inaccessible to him. There are no limits for his propagation. By his life, the scientific thought and state-organized technique guided by it, man creates the new biogenic force in the biosphere, directing his propagation and creating favorable conditions for the population of the biosphere parts, into which his life has not penetrated yet, and even those places where there has been no life before.

Humanity is one whole, and although it is mainly realized, the unity is manifested in the forms of life, which actually deepen and strengthen it imperceptibly to humans, spontaneously, as a result of the unconscious appetence to it. The life of humanity, with all its diversity, has become indivisible, united. The event that happened in the remote corner anywhere, of any continent or ocean, is reflected and has consequences – large and small – in a number of other places everywhere on Earth surface. Telegraph, telephone, radio, TV, planes, satellites have covered the entire globe.

Communications are becoming simpler and faster. Every year their organization is increasing, is growing rapidly.

The scientific thought reached such depths of the matter structure that mankind learned to create artificial chemical elements, to artificially initiate and accelerate radioactivity. Now it is possible to conduct organic synthesis, create new strains of bacteria, species of plants and biological organisms. Moreover, mankind started to create artificial human organs and their transplantation.

It is clearly seen that this is the beginning of spontaneous movement, natural phenomenon that cannot be stopped by contingencies of human history. Here for the first time, perhaps, the relationship of historical processes with fossil history of the emergence of Homo sapiens is so evidently revealed. This process of the total population of the biosphere by man is conditioned by the course of history of scientific thought, it is inseparably connected with the rate of relations, successes in the mobile machinery, possibility of instant transmission of a thought, its simultaneous discussion everywhere on the planet.

The fight against this major historical trend causes ideological opponents to actually obey it. State formations, which do not ideologically recognize the equality and unity of all people try, not ashamed of the means, to stop their spontaneous manifestation, but there is little doubt that these utopian aspirations cannot be securely realized. This will inevitably redound with the course of time, sooner or later, since the creation of the noosphere from the biosphere is a natural phenomenon, deeper and more powerful in its base than human history. It requires the existence of mankind as a whole. This is its inevitable prerequisite. This is a new stage in the planet history, which does not allow using its historical past for comparison without amendments. For this stage creates substantially the new in the history of Earth, and not only in the history of mankind.

Man first really realized that he is an inhabitant of the planet, and he can and must think and act in the new aspect, not only in the aspect of an individual, family or genus, states or their alliances, but also in the planetary aspect.

He, like all living beings, can think and act in the planetary aspect only in the field of life – **in the biosphere**, in particular earth shell, with which it is inseparably, naturally linked and from which he cannot escape. His existence is its function. He carries it with him everywhere. And he is inevitably, naturally, constantly changing it.

A man capable of labor is the creation of nature and society. And through labor the humanity creates and transforms Earth. **Noosphere, the sphere of mind, is by its very nature the sphere of labor.** But the sphere of labor is not self-sufficient area of people interaction cut off from the natural dependence. Here, the carrier of labor capability himself – Homo sapiens – is the result of the evolutionary process on Earth. Mankind becomes a geological force called upon by the very evolution to be the power of mind and with its transformative activity to continue the evolution of Earth in the direction of saving the biosphere from the destruction of ever-increasing excess of energy coming from Sun and Universe.

Humanity is called upon by the development history to become the keeper of its habitation. The evolution of Earth itself, the evolution of processes of substance and energy conversion in inorganic and organic world led to such a state that a biological organism appeared, which does not only convert substance and energy, but also creates something different from substance and energy – **the ideas**, which are called information in the modern language.

HOMO SAPIENS FABER

The centuries-old dispute between idealists and materialists still remains unsolved in philosophy. Still there are discussions on the primacy of matter or spirit. At the same time, the controversial question on the essence and measure of labor is still disputable. The difference of a human in the biological fauna consists primarily in the fact that he is able to work – to put forward an idea and implement it in his activities by creating new things and processes compared to natural bodies and phenomena. **Man converts and accumulates the information.** This is his fundamental difference from all congeners in the animal kingdom. But a human can become the transmitter and accumulator of information only in human society in the process of social labor. Man capable of labor, performing the labor **becomes a person**. One of the groups of persons (Homo sapiens faber) comprises people of science whose labor is a high form of informational process.

The creator of the informational field of knowledge on the noosphere, a philosopher and naturalist V. I. Vernadsky uncommonly and clearly reflected the essence of scientific labor both by the books (information) left for his generation and by his actual life as a scientist. "By slow, hard, accurate, quantitative account – **first of all, by the measurement** (emphasized by us) – and by no less accurate scientific description of the surrounding, the science and natural science, in particular, are moving forward. Millions, a gillion of facts are covered by convenient techniques newly created for this. And only with deepening and accounting the so-processed countless empirical material – with maximum precision and subtlety of accounting and description – the science can move forward.

Only occasionally, in the epochs of scientific thought blossom, there are revealed the new opportunities of such coverage of scientific facts, countless phenomena of nature and conversion of them into the instrument of penetration into the unknown – new fields of facts are opened. For a scientist it is clear that it is impossible to embrace the boundless, to express the nature of our reality and ourselves with words and notions. We can brightly feel the boundless only working on concrete facts. While working on scientific facts, actively entering the nature in its individual empirical areas, by this action the scientist is experiencing the reality of the world so fully and deeply that a person cannot do it in other forms of his consciousness. This is the largest and deepest – and complete – what is available for Homo sapiens faber spontaneously connected with the biosphere by his existence, whose integral part he is.

Steadily studying the infinite nature, bottomless reality, embracing countless facts and going into them during the long life, a scientist, brighter than anyone, can realize the impossibility of explaining it in simple and clear verbal images. This feeling is senseless for a thinker, staying away from the empirical establishment of facts, from their collection and comparison. This inability is linked with the fact that a man, Homo sapiens faber, is only the transient stage in the evolution of forms of a living substance closely connected with constantly changeable nature, in which inseparably and spontaneously he himself and potentially new future manifestation of life, which will replace him – a future non-Homo sapiens – are revealed" [Vernadsky V. I. Essays on geochemistry. Moscow: Nauka, 1983. P.257].

STEPPED NOOEVOLUTIONAL PROCESS

"Over the last dozen – two dozen thousand years the geochemical impact of humanity that captured green living substance by agriculture, has become unusually intense and varied. We see the amazing growth rate of the geochemical work of humanity. We see a still greater influence of consciousness and collective mind of man on geochemical processes. Man introduced a new form of impact of a living substance on the atom exchange between the living substance and inert matter into the world structure. Previously, the organisms affected the history only of those atoms, which were necessary for their growth, propagation, nutrition, breathing. Man extended this range, affecting the elements needed for engineering and for the creation of civilized life forms. Man acts here not as Homo sapiens but as Homo sapiens faber (man of sense, producing, creating)" [Vernadsky V. I. Essays on geochemistry. Moscow: Nauka, 1983. P.257].

SUMMARY

All that was said, can be represented as a block diagram of the evolutionary process on Earth (Fig. 2.1).

We divide all forms of the evolutionary process into two kinds:

- Natural processes;
- Noologic (rational-human) processes.

In any individually considered process and in the totality of the processes the substance, energy and information conversion proceeds simultaneously.

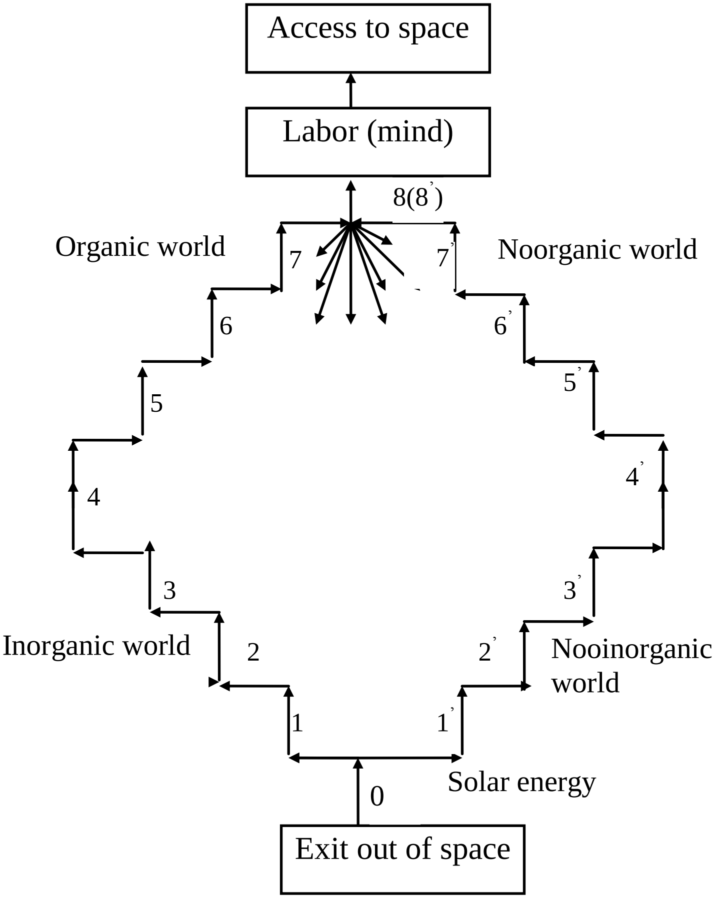


Fig. 2.1. Scheme of stepped nooevolutional process on Earth

Inorganic world

1. Gaseous natural substances.
2. Liquid natural substances.
3. Solid natural substances.
4. Radioactive natural substances.

Organic world

5. Microorganic world.
6. Vegetational organic world.
7. Animal natural world.
8. Humanity.

Nooinorganic world

1'. Gaseous artificial substances.
2'. Liquid artificial substances.
3'. Solid artificial substances.
4'. Radioactive artificial substances.

Noorganic world

5'. Microorganisms are artificial.
6'. Artificial vegetation-like.
7'. Artificial animal-like.
8'. Noorobots.

Evolutionary processes are depicted in the diagram in the form of stepped graphs . This image is taken by us for the schematic representation of the law of transition of quantitative changes (accumulation) into a new qualitative state. The horizontal arrow ($\rightarrow$) – quantitative change inside the given state of substance, and the vertical arrow ($\uparrow$) – jump from the given state into the new state, change of quality.

The substance is converted in the processes, transiting from one state into another, it retains its mass after the conversion.

The energy is converted in the processes from one form into another, and the total amount of energies before and after the processes is preserved.

The information is generated by the processes of substance and energy conversion, testifies the forms and number of conversions and is accumulated in the corresponding forms on the carriers.

The inorganic world is the totality of inorganic compounds formed by chemical processes of solar energy interaction with the substance of Earth, but not possessing the property of life.

The inorganic world is available on Earth in three aggregation states: gaseous, liquid and solid. Substance density (ρ) is the main quantitative characteristic of the aggregation states:

$$\rho = \frac{M}{V},$$

i.e. the ratio of the substance mass (M) to its volume (V).

The transition state from inorganic to organic is a radioactive state, i.e. the state when the given substance has an excess of internal energy and it can radiate it into the environment.

Now the notion of radioactivity as the ability of some atomic nuclei to transform into other nuclei with the emission of particles has already become common. The alpha decay, beta decay, spontaneous division of nuclei accompanied by gamma radiation are the examples of radioactive transformations. We distinguish the natural radioactivity, i.e. the radioactivity of isotopes that exist in nature, and artificial – the radioactivity of isotopes produced in nuclear reactions. One becquerel (Bq) called after the French scientist A. Becquerel is accepted as the quantitative measure of radioactivity. 1 Bq equals the activity of nuclide (atomic nucleus) in the radioactive source, in which one act of decay takes place in one second. In addition, the radio emission activity is expressed by the specific radioactivity through the ratio of radioactivity (Bq) to the mass of radioactive material (m), i.e.:

$$\mathrm{Bq}_m = \frac{\mathrm{Bq}}{m}.$$

The organic world is a set of organic substances formed from the inorganic ones as a result of chemical processes of Sun interaction with the substance and energy of Earth, having the property of life.

The organic world is represented by microorganisms, plants, animals. In this series of substance, energy and information conversion, there is a quantitative characteristic associated with biological productivity (β) and release of free energy during photosynthesis (*hv*) that can be expressed by the formula:

$$\beta = \frac{B}{t},$$

where *B* – biological mass of the producer during the life cycle;

t – duration of the life cycle in time.

KINGDOM OF LABOR PROCESSES

The kingdom of humanity is especially distinguished in the organic world. Mankind, as well as everything living and lifeless on Earth, converts substance and energy, but differs in the specific ability to accumulate information, i.e. special practicability of actions. This ability forms the kingdom of special processes – **labor processes**. The ability of mankind to convert the substance of Earth, referred to the total of its biomass, can serve as the quantitative characteristic here, i.e.

$$\gamma = \frac{W}{B_h},$$

where W – mass of Earth substance converted by human labor;

B_h – biomass of humanity;

γ – productivity of humanity.

In addition to Earth substance, the mankind converts the energy of nature, thus increasing the value of its geological force, consequently:

$$\varepsilon = \frac{E}{T},$$

where E – energy of nature converted as a result of human labor;

T – amount of labor committed by humanity during the considered period of geological time.

Each generation of mankind starts its labor activity based on the information (knowledge) of the previous generation, and thus, humanity deals with the objective law of nature – **law of information accumulation**. It follows that

$$J_1 < J_2 < J_3 \ldots < J_k \qquad \text{and} \qquad e = \frac{J_k}{T} \to \max,$$

where J_k – information accumulated by mankind as a result of labor activity by the period "k".

The foregoing is an additional confirmation of the provisions made by V. I. Vernadsky that mankind on Earth manifests itself as progressive geological force and this force is manifested in the form of constantly evolving labor activity related to the conversion of natural substances and organisms, conversion of natural energy and accumulation of information. Following V. I. Vernadsky, we call this process the nooevolutional process, or otherwise – evolution of mind.

The pointed out arguments are expressed on the scheme of nooevolutional stepped process on Earth (Fig. 2.1.) as follows: solar energy (gravitational and electromagnetic) affects substances of Earth and interacts with its resistance energy (gravitational and electromagnetic).

Due to the energy of Sun the constant changes in the aggregation state of inorganic substances take place, the accumulation of excessive energy is manifested in the substance radioactivity. The exposure to radioactivity of substances of Earth and Sun gives rise to the organic life and constant progressive chain of changes in the state of organic variety and acquisition of information in the human manifestation of labor power.

Mankind, manifesting itself as a geological force of reason, creates artificial technological processes of substance conversion. Artificial substances are formed and constantly accumulated as new forms of inorganic world also in three aggregation states and by the content satisfying human needs. We call this world of substances – nooinorganic (reasonably inorganic) world of substances.

Human activity tends to create the reasonable (nooorganic) world of organisms, becoming helpers of humanity in the process of evolution and, therefore, increasing its geological force of substance and energy converter. Modern development of society already allows creating powerful machines converting substance and energy, producing artificial radioactive substances and implementing the processes emitting them, creating new microorganisms, plants and something like animal world and initiating the bold human dream – to fly in the outer space.

Thus, the energy of Sun converted on Earth into the form of inorganic and organic substances and energy and substance converters reaches its climax – creation of man as a substance and energy converter and information converter and accumulator. Man becomes a powerful geological force capable to continue a variety of natural processes of conversion (inorganic and organic world) in the form of artificial (rational) conversion processes (nooinorganic and nooorganic world). This latter process of the manifestation of geological forces of man is still only at the beginning of its formation, only at the initial stage of the powerful manifestation of its converting force. The future development and salvation of Earth from its spontaneous destruction is in the “hands” of human society. Hence is man’s need for the knowledge of the laws and regularities of his own manifestation in the variety of Sun and Earth energy converters.

Mankind is inevitably forced under the pressure of excessively accumulated energy of Sun on Earth to create such substance and energy converters that would seize and send the excessive energy of Sun out of Earth and its electromagnetic field. **Man is the savior of Earth from its destruction by the excessive energy of Sun!** The global thoughts of humanity are directed at solving this top priority.

When the creation of nooinorganic and nooorganic variety of substance and energy converters is completed by humanity (Fig. 2.1, the right side of the diagram), only then the necessary part of Sun energy follows the natural series of conversions reaching the maintaining of the physiological existence of man, and the excessive part of Sun energy will be perceived by artificial (nooinorganic and nooorganic) converters and sent into the outer space in accordance with the balance of substance and energy needed to preserve Earth.

Thus, we have the magnificent geological force of mankind – productive force of labor activity of society.

“Therefore, the labor as a creator of values in use, as useful labor, is the condition of human existence, eternal, natural necessity independent of all social forms: without it, the substance exchange between man and nature would be impossible, i.e. the human life itself would not be possible” [Marx, K. Capital. V.1. M.: State publishing house of political literature. 1952. P. 49].

3
Substance

The environment around a human being is material and, above all, macroscopically material. A thing is any part of the material world, which has a relatively independent and stable state. A substance is characterized by the integrity of properties, through which it is connected and interacts with other substances.

AGGREGATE STATES

From the standpoint of physics, a substance is a kind of matter with a rest mass. Physics distinguishes an amorphous substance – a solid, not having an ordered structure; a crystalline solid – a solid having periodic arrangement of the constituent particles; optically active substance – a substance able to cause rotation of polarization plane of light passing through it; surfactant – a substance able to adsorb at the interface and lower the surface energy of phases; radioactive substance – a substance in which the radioactive decay takes place.

Thus, **physics considers inorganic substances in four aggregation states: gaseous, liquid, solid and extra-hard – radioactive state**.

Chemistry examines a substance through the notions of a chemical element and compound. The interrelation, regularities and properties of elements are reflected in Mendeleev's Periodic Table. Chemistry studies the laws of substance transformation. The gravimetric analysis is an important method for quantitative chemical analysis, which considers weighing not only as the initial but also as the final stage of determination. The weight analysis is based on the law of mass conservation of substances in chemical transformations.

RADIOACTIVE SUBSTANCES

The special place in the evolutionary row is occupied by ***radioactive substances***, consisting of radioactive elements, i.e. chemical elements, whose all isotopes are radioactive. Radioactivity (from Latin radio – radiate and actives – active) – spontaneous transformation of unstable isotopes of a chemical element into the isotopes of another element, accompanied by the emission of elementary particles or nuclei (e.g., helium). There are two main types of radioactivity: α-decay and β-decay, often accompanied by the emission of γ-rays. The rate of radioactive decay is characterized by half-life. *Curie* is the most common unit of radioactivity measurement.

BIOINERT SUBSTANCE

Biology deals with living substances, i.e. with the aggregate of the bodies of living organisms inhabiting Earth. When studying living organisms, biology investigates biogenic, bioinert, intercellular, physiologically active substances.

Biogenes (Greek bios– life+ genos–being born, born) – substances, including chemicals, absolutely necessary for the existence of living organisms and always contained in them; substances emerging as a result of decomposition of organism debris but not yet fully mineralized; substances formed by a living organism and linked with its vital functions (phytoncides); substances having a stimulating effect on the organism, including biogenic stimulants produced in the organism and having a significant impact on it (accelerate regeneration, etc.) due to high biologic activity.

Bioinert substance "... is formed both by living organisms and inert processes" and is "a regular structure of living and inert substance" (V. I. Vernadsky). A bioinert substance is especially indicative for soil, practically all of the surface layers of Earth (sedimentary rocks) are the result of the bioinert substance transformation.

Intercellular substance – structureless amorphous mass composed of the finest thread-like structures (fibrils), particularly well developed in the connective tissues and determining their structure.

Physiologically active substance – any substance produced by the organism obtained from outside and providing either stimulatory or inhibitory effect on the processes in the organism. Physiologically active substances include biogenes, hormones, inhibitors, enzymes, plant hormones (growth substances), and others.

Species is the basic unit of biological evolutionary process – qualitatively isolated form of a living substance.

Thus, **all the surrounding space is filled with physical bodies formed by various substances. Substances can be in three aggregate states – solid, liquid and gaseous, depending on the pressure temperature. Substances are formed from chemical elements**.

The main parameters of substances are mass, volume, density, chemical structure and radioactivity.

SUBSTANCE STRUCTURE

Substance structure is quantified by chemical formulas of reactions, in which some substances are transformed into other, different from the original composition and properties. Unlike nuclear reactions, in chemical reactions atoms themselves do not undergo transformations but only move from one compound to another. There are several basic types of chemical reactions:

combination $2Cu + O_2 = 2CuO$,

decomposition $2MgO = 2Mg + O_2$,

substitution $Fe + CuSO_4 = Cu + FeSO_4$,

exchange $NaOH + HCl = NaCl + H_2O$

Elements are always interconnected in certain weight proportions corresponding to their chemical equivalents.

PHYSICAL AND MATHEMATICAL SUMMARY

Mass is a scalar value, which is a measure of the body inertia in progressive movement. Mass m of a material point is the ratio of the vector modules of its weight P and gravitational acceleration g:

$$m = \frac{P}{g} = \frac{[\mathrm{H}]}{\left[\frac{m}{\mathrm{sec}^2}\right]} = [\mathrm{kg}]$$

Body mass in Newtonian mechanics is additive: it equals the arithmetic sum of the masses of all material points that are part of this body. The experiment demonstrates that gravitational accelerations are the same for all bodies in the same observation point. Therefore, the ratio of masses of two bodies equals the ratio of their weights:

$$\frac{m_2}{m_1} = \frac{P_2}{P_1};$$

The comparison of masses of bodies with the help of lever scales is based on it.

Body **density** ρ is the limit of the ratio of mass Δm of body element to its volume ΔV when ΔV is tending to zero:

$$\rho_{\Delta V \to 0} = \lim \frac{\Delta m}{\Delta V} = \frac{dm}{dV}.$$

The total body weight is

$$m = \int_0^V \rho dV,$$

where the integration is extended to the entire volume V of the body.

In a homogeneous body its density is constant throughout the entire volume V and body mass $m = \rho\, V$.

The average density of a heterogeneous body ρ_{av} is the ratio of the body mass to its volume:

$$\rho_{av} = \frac{m}{V}.$$

In classical mechanics it is assumed that

a) body weight does not depend on its movement velocity;

b) mass of an isolated system of bodies does not change during any processes occurring in it. **This is the law of mass conservation first formulated M. V. Lomonosov**.

The body weight is force P with which a body stationary relative to Earth presses upon the support due to its attraction to Earth. The body weight equals the vector difference between a body gravity force F to Earth and centripetal force F_c resulting in the body daily rotation of Earth:

$$P = F - F_c,$$

and

$$F_c = m\, \omega^2 R \cos\varphi,$$

where m – body weight;
ω – angular speed of daily rotation of Earth;
R – radius of Earth;
φ – geographical latitude of the observing site A.

The body **gravity center** is the application point of the resultant force of the weight of all the body particles. The body gravity center coincides with its **center of inertia**.

Natural radioactivity is quantified by spontaneous decomposition of atomic nuclei calculated following the formula:

$$N = N_0\, e^{-\lambda t},$$

where N_0 – number of nuclei in the given volume of the substance at time $t = 0$;
N – number of nuclei in the same volume at time t;
λ – decay constant.

Constant λ is the probability of nucleus decay and it equals the fraction of nuclei that decay per second. The value of $1 / \lambda$ is called an average life of a radioactive isotope.

To characterize the stability of nuclei against decay the notion of half-life $T_{1/2}$, equaled to the time during which the initial number of the substance nuclei decay by half, is used. The relation of the values:

$$T_{1/2} = \frac{\ln 2}{\lambda}.$$

The number of nuclei decays of the given specimen per time unit is called the specimen activity. If referred to a mass unit, this number is called the specific activity of the specimen substance. Activity:

$$A = \lambda N_0 e^{-\lambda t},$$

The natural radioactivity is a universal phenomenon among the heavy atoms (starting from $A > 200$).

4
Forces in nature

At first glance, the picture of interactions in nature looks infinitely complex. However, physics considers the diversity of interactions through the action of a very small number of different forces.

MOTION GENERATES A FORCE

“The notion of force arises by itself due to the fact that we have the means in our own body to transfer the movement. These means can, within certain limits, be powered by our will. It applies especially to the muscles of arms, with which we perform mechanical movements, movements of other bodies, lift, carry, throw, hit, etc., thus producing useful effects. It seems that here the movement **is generated**, not transferred, and it makes an effect that a force generally **generates a movement**. Only now it is physiologically proved that muscle force is only the movement transfer”. [Engels F., Dialectics of nature. Moscow: Publishing house of political literature, 1965. P. 245].

Hence it is clear that the feelings that occur in a human when acting upon the surrounding bodies to bring them in motion with his body formed the basis for understanding force in mechanics. But “because every conscious force application by a human is preceded by volition, behind the physical notion of force we were looking for something deeper, metaphysical, some desire inherent to bodies. In case of, for example, the gravity force – the desire to get connected with his like. It is difficult for us to understand this point of view” [Grigoriev V., Myakishev G. Forces in nature. P.11].

A critical statement underlies the materialist view of evolutionary processes in nature: “If Hegel considers force and its manifestation, cause and action as identical, then it is proved in the change of matter form, where their equivalence is proved mathematically. This equivalence has been previously recognized in the world: force is measured by its effect, cause – by action” [Engels F., Dialectics of nature. Moscow: Publishing house of political literature, 1965. P. 245]. Consequently, force is the result of interaction of bodies in their motion. According to the law of motion indestructibility, force equals exactly its effect. Here, we deal with the function of interrelation of various bodies in their motion, and the force becomes the quantitative measure of this motional interrelation. However, the transferred movement can be quantified to a certain degree as it appears in two bodies, one of which can serve as a “unit-measure” for measuring the movement in the other. **It is the measurability of motion that gives value to the strength category**.

MOVEMENT MEASURABILITY

With the development of science and measurement practices, various forms and types of movements become increasingly available for measuring, and therefore, the degree of suitability of motion force category for investigation increases. Only one reference-book of physics lists 55 different forces, although actually it is clear that these are different quantitative measures of moving and interacting bodies.

According to Newton, the world consists of “solid, weighty, impenetrable, movable particles”. These “primary particles are absolutely solid in comparison with the bodies composed of them; they are so hard that they are never worn out and do not shatter”. The particles differ from each other mainly by quantitative characteristics. All the wealth, all the qualitative diversity of the world – the result of differences in the motion of particles. Motion is the main thing in this picture of the world. The inner essence of matter particles remains on the background: the main thing – how the particles move.

The basis for this view of the world lies in the comprehensive nature of Newton’s laws of motion of bodies, to which he gave a strict mathematical form. Enormous celestial bodies, as well as the finest grains of sand driven by the wind are subject to these laws with surprising accuracy. Even the wind – the movement of invisible particles of air – follows the same laws [Grigoriev V., Myakishev G. Forces in nature. P.11].

The universality of motion laws is convincingly simply and clearly reflected in the above phrases quantified by Newton.

LONG-RANGE FORCES

Eventually, the interaction chain of physical bodies, chemical reactions, biological, geochemical and thermonuclear processes leads to the interaction of fields, whose primary cause is the interaction of electromagnetic and gravitational fields of the solar system and Universe. God still reigns, and politics under his cover, where the science has not found yet the quantitative methods and measures for measuring the interaction force.

Visually, the gravitational field can be represented by threads extending from one body to another. The countless number of such threads would have penetrated the space anywhere, and it is impossible to break such a thread, block the gravitational forces. The gravitational interaction is freely transferred through any body. All the things existent are imprisoned by the gravitational field. Therefore, the action of forces of universe gravitation extends continuously decreasing practically at the unlimited distance; as physicists say, the radius of their action is infinite. Thus, **gravitational forces are long-range forces**, whereby the gravity binds all bodies in Universe.

FORCES OF ELECTROMAGNETIC FIELD

Elastic forces allowing solids to preserve their shapes, preventing changes in the volume of liquids and compression of gases; **friction forces** impeding the movement of solids, liquids and gases; **forces in biological bodies** and, of course, of our muscles – all of them are the members of a large family. All of them have common nature, common origin: **these are forces of electromagnetic field**. The nature provided electromagnetic forces with the widest arena of activities. In everyday life, except for Earth gravity and tides, we meet only with different types of electromagnetic interactions, and even the elastic force of steam, as it turns out, has electromagnetic nature.

The atomic shell structure, cohesion of atoms in molecules and formation of substance lumps are determined solely by electromagnetic forces.

FORCES OF CHARGED BODIES

One of the manifestations of interaction is the action of electrically charged particles. In the process of electrification by friction, as we know very well now, the most movable charged particles – electrons – move from one body to another. As a result of this transition, the body which has lost electrons, is positively charged, and the one which obtained them in excess – negatively. The discovery of interaction of electric charges immobile relative to each other was made under the direct influence of Newton's ideas, according to the law of universe gravitation.

Coulomb's experiments with torsion balance led to the discovery of the law surprisingly resembling the law of gravitation, namely: **force of interaction of immobile charged bodies is directly proportional to the product of their charges and inversely proportional to the square of the distance between them**.

The discovery of Coulomb's law for the first time allowed considering the charge as a certain amount – to measure it. For this purpose it is necessary to have a unit of measurement. It is Coulomb's law that makes it possible to find this unit. After all, it is practically impossible to create a standard of charge, similar to the standard of length – meter, due to the constant charge leakage.

MAGNETIC FORCES

There is another form of interaction. These are magnetic forces. Who was not amazed by wonderful properties of magnet when a child? The attraction of magnets at a distance resembles the attraction of electrified bodies. No wonder they were confused for centuries. Only in the end of XVI century Gilbert was able to prove that they are not the same.

The inseparable magnetic poles of molecules seen by Coulomb were simply closed electric currents. **Magnetic interaction is conditioned not by special magnetic**

charges, like electric ones, but the movement of electric charges – current.

It is curious that the fruitfulness of the idea of the unity of forces of nature, perhaps, has not been so clearly revealed anywhere else as in the formulation of basic laws of electromagnetism. Inspired by this idea, Oersted brought a magnetic needle to the current-carrying conductor, and Ampere managed to see in his mind's eye electric currents inside a magnetic piece of iron. The same idea led Faraday later to the new great discovery – the discovery of electromagnetic induction.

Strenuous efforts were finally a complete success. Ampere discovered the law of mechanical interaction between electric currents, thus solving the problem of magnetic interaction. Ampere's discovery expands our understanding of electric charge. We find a new fundamental property of charges: the ability to interact with forces depending on the movement speed.

PHYSICAL AND MATHEMATICAL SUMMARY

Force is a vector value, which is a measure of mechanical action upon a material point or body by other bodies or fields. The force is completely set if its numerical value, direction and point of application are given. The interaction between the bodies is the cause of changes in their movement state. Furthermore, it also causes deformation of bodies. Measuring deformation x_1 and x_2 of the same elastic body under the action of two equally directed forces F_1 and F_2, applied in the same point, it is possible to compare the numerical values of these forces:

$$\frac{F_2}{F_1} = \frac{x_2}{x_1}.$$

This method based on Hooke's law is implemented in spring balance and dynamometers.

The action upon material point A by several bodies with forces F_1, F_2...F_k is equivalent to the action of one force, called the resultant force and equaled to the vector sum of these forces:

$$F = \sum_{i=1}^{k} F_1$$

The momentum (impulse) of a material point is vector k_i equaled to the product of mass m_i of the point by its velocity v_i:

$$k_i = m_i v_i.$$

The amount of movement of the system of n material points is vector K equaled to the geometric sum of the amounts of movement of all the system points:

$$K = \sum_{i=1}^{n} m_i v_i.$$

When considering the translational motion of a solid body, this body can be replaced in one's mind's eye by the material point, which coincides with the body center of inertia that has all its weight and moves under the action of the principal vector of external forces applied to the body. Hence

$$\frac{\mathrm{d}K}{\mathrm{d}t} = F, \text{ or } mw_s = F,$$

where $\dfrac{\mathrm{d}K}{\mathrm{d}t}$ – time derivative of momentum;

w_s – acceleration of the system center of inertia;

m – mass of the system of material points (body).

Forces of mutual attraction, directly proportional to the product of the masses of these points and inversely proportional to the square of the distance between them, act between any two material points (bodies):

$$F_{12} = \mathrm{f}\ \frac{m_1 m_2}{R^2}\frac{R_{12}}{R},$$

where F_{12} – gravitation force acting upon the point with mass m_1;

R_{12} – radius-vector drawn from the point with mass m_1 to the point with mass m_2;

R – distance between the points;

f – gravitation constant whose numerical value depends on the choice of unit system.

Electrostatics is the study of properties and interactions of electric charges immobile against the coordinate system chosen for their study. According to Coulomb's law the force of electrostatic interaction:

$$F_{12} = k_1 \frac{q_1 q_2}{r^2}\frac{r_{12}}{r}, \text{ in the scalar form } F = \frac{1}{\varepsilon}\cdot\frac{q_1 q_2}{r},$$

where q_1 and q_2 – point electric charges;

r – distance between the charges;

r_{12} – radius-vector connecting the charges;

k_1 – proportionality coefficient depending on the properties of the environment, in which the interaction occurs, and the selected system of measuring units;

ε – relative dielectric permeability of the environment showing in how many times the interaction force between the charges is reduced in the given environment compared to vacuum.

Scalar value J equaled to the first derivative by time from charge q passing through the surface is ***the force of electric current*** through some surface S:

$$J = \frac{dq}{dt} \quad \text{at } DC \quad J = \frac{q}{t}.$$

For the closed circuit the algebraic sum of all the electromotive forces acting in this chain:

$$E = J\,R,$$

where R – total resistance of the entire circuit.

Magnetic field is a form of matter, the most important property of which is that the field acts upon the moving charged particle with the force that depends on the product of its charge by speed. The main characteristic of the magnetic field is the magnetic induction vector B. The vector is found following Ampere’s law, which expresses the force that acts upon the conductor length element with current J placed in the magnetic field:

$$dF = kJ\,[dlB],$$

where dF – force;

dl – vector of the conductor length element made in the direction of the current;

k – proportionality coefficient depending on the choice of measuring units for all values in the formula.

Electromagnetic induction phenomenon is that in the conductive contour placed in the alternating magnetic field, electromotive force of induction E_i arises. If the contour is closed, then it generates the electric current called the induction current. In accordance with Faraday's law of electromagnetic induction, the electromotive force of electromagnetic induction in the contour is numerically equaled and opposite in sign to the rate of the change in the magnetic flux through the surface limited by this contour:

$$E_i = -\frac{\mathrm{d}F_m}{\mathrm{d}t}.$$

5
Energy conversion

"If ten years ago the newly discovered fundamental law of motion was understood only as a simple law of energy conservation, as a simple expression that movement cannot be destroyed or created, i.e. understood only from the quantitative aspect, this limited and negative expression is more and more substituted by the positive expression in the form of energy conversion law, where the qualitative content of the process first starts to set in and the last memory of the Maker is erased. Now there is no need to preach something new any longer, the momentum (so-called energy) does not change when it is converted from kinetic energy (so-called mechanic force) into electricity, heat, potential energy of position, etc., and back; this idea serves as the basis of a now more informative investigation of the conversion process itself produced once and for all, such **a great fundamental process** (emphasis added), within the meaning of which the entire knowledge of nature is summarized" [Engels F., Anti-Dühring. Moscow: Publishing house of political literature, 1951. P. 13].

These reflections were written by Engels over a hundred years ago. The development of various areas and fields of science with each significant discovery of natural phenomena and even quite simple physical and chemical experiments conducted in the laboratory on a daily basis every time support this brilliant philosophical generalization of the evolutionary process of nature and people community living in it.

However, we will try to consistently study this fundamental principle, which has already become the common knowledge.

ENERGY

In the preceding discussions of the matter and forces various interaction forms of forces and fields were indicated. It was noted that electromagnetic field cannot be described as a system of material points moving following the laws of Newtonian mechanics. All the terms of mechanics, the whole range of its images are not suitable to describe an object. If the mechanical description becomes meaningless, it is necessary to introduce some other interaction measures. They can be found quite easily. Energy perfectly suits this role. Energy description becomes unique in many processes. Energy is so universal that the law of energy conservation is also applied to elementary particles, and macroscopic, production, socio-economic and even political processes. However, in each of the processes the law of energy conversion and conservation acquires the proper manifestation form.

Of course, we could do without the word "force" and completely describe the processes through the notion of "energy". But, apparently, the habit to use the word "energy" is so great, it is so firmly established in our language that it will most likely be preserved in future. Not only common but also scientific words live their own lives, and they can be thrown out with neither "reasonable" arguments against them, nor statutorily. Consequently, force and energy are interpenetrating notions related to the same comprehensive law of energy conversion and conservation. The force understanding greatly simplifies the understanding of energy.

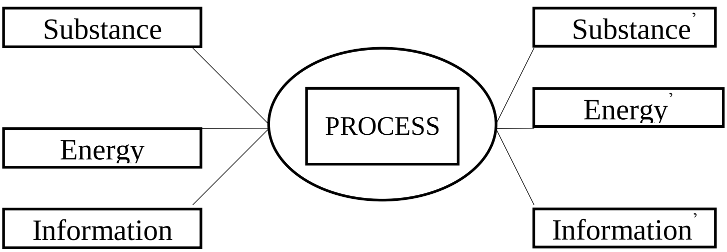
However, there is a common thing in understanding both force and energy. Neither force nor energy exist outside the substance and are revealed without the interaction process. They are quantitative indexes of the state of interaction processes.

CONVERSION PROCESS

Process (from Latin processus – passing, promotion): 1) succession of states, close connection of naturally successive stages of development representing a continuous single movement, e.g., operation process, plant development process, a process in lungs, etc.; 2) court case, order of activities of investigative, prosecutorial and judicial authorities.

Physical, chemical, biological, geological, judicial, psychological, political, administrative, etc. – these are the varieties of the great, comprehensive evolutionary process.

In general abstract representation, each single specific form of the process can be qualitatively and quantitatively represented through material, energy and information processes. This can be schematically displayed as follows:



Matter, energy, information in any process are changing as a result of interactions within the process, and they are transformed into a new form to immediately enter a new subsequent conversion process. There is nothing outside processes. Even time and space are absent without interaction processes.

Energy (from Greek energeia – activity): 1) one of the fundamental properties of matter – measure of its motion; main varieties or forms of energy: mechanical, thermal, electrical and electromagnetic, chemical, nuclear; various forms of energy can be converted into each other in strictly defined proportions; for all energy conversions its total amount does not change; law of energy conservation is the fundamental law of modern natural science; 2) in the broadest sense – active force, insistence, cheerfulness.

This is a brief explanation of the word "energy" in the dictionary of foreign words, but it is quite enough for the understanding of comprehensive energy meaning in public life and understanding of the entire evolutionary process of nature. Quantitative characteristics of various forms of energy conversion produce physical and chemical equations, the most significant of which are given in physical and mathematical summary.

PHYSICAL AND MATHEMATICAL SUMMARY

Energy is a unified measure of various forms of movement. Energy is a scalar quantity. The corresponding types of energy are introduced for quantitative characteristic of qualitatively different forms of motion considered in physics.

The essence of the law of energy conservation and conversion: in any processes taking place in an isolated system, its total energy does not change. If the system is not closed, the change in its energy due to external actions numerically equals and is opposite in sign to the algebraic sum of all the energy changes of all external bodies and fields interacting with the system.

Changes in the body energy in processes of the work performance and heat exchange are called work and heat, respectively, or amount of heat imparted to the body.

Work A of force F on the final portion of s trajectory of the shift of its application point equals the algebraic sum of elementary works of this force on all infinitely small portions of the trajectory:

$$A = \int (F\mathrm{d}r) = \int F_\tau \mathrm{d}s,$$

if F_τ = const, then $A = F_\tau\, s$.

The work in the International System of Units is measured in joules (J).

Power N of force F is a scalar value that characterizes the speed of performing the work by this force, and that equals the ratio of the elementary work δA to the time interval dt during which it is performed:

$$N = \frac{\delta A}{\mathrm{d}t} = \left(F\frac{\mathrm{d}s}{\mathrm{d}t}\right) = (F\nu),$$

where F – force, Newton (N);

v – velocity of the shift of force application point, m/sec;

N – power, watt (W).

Mechanical energy W is the energy of mechanical motion and interaction of bodies. It equals the sum of kinetic W_k and potential W_p energies:

$$W = W_k + W_p.$$

Kinetic energy of the translational motion of the body with mass m with velocity v:

$$W_k = \frac{mv^2}{2}.$$

Energy, as well as work, is measured in joules.

If the body rotates around a fixed axis, its kinetic energy equals half of the product of the moment of inertia with respect to the rotation axis by the square of angular velocity ω:

$$W_k = \frac{J\varpi^2}{2}.$$

The kinetic energy of the body, which moves translationally with velocity and simultaneously rotates with angular velocity ω around the axis passing through the body center of inertia equals the sum of the translational and rotational kinetic energies.

Potential energy is the energy depending only on the mutual position of interacting material points or bodies; not only the potential energy change but also its absolute values can be measured in any experiment.

The potential energy of a body with mass *m* located in the gravitational field of Earth is as follows:

$$W_p = -\mathrm{f}\,\frac{mM}{r} + c = m\varphi + c,$$

where M – mass of Earth;

$\varphi = -\mathrm{f}\,\frac{M}{r}$ – potential of the gravitational field of Earth;

f – gravitational constant;

r – distance from Earth center to the point of potential energy determination.

FIRST LAW OF THERMODYNAMICS

In thermodynamics we generally consider macroscopically immobile systems, for which the change in the total energy equals the change in internal energy, so that

$$Q = \Delta U + A.$$

Heat Q transferred to the system is spent for increasing its internal energy ΔU and performing work A by the system against external forces. When Q is measured in thermal units and other values – in mechanical ones, then

$$\Delta W = J\ Q + A\ ,$$

where J – mechanical equivalent of heat unit
(J = 4,18 J/cal = 0,427 kgm/cal).

The first law of thermodynamics, which expresses the universal law of energy conservation and conversion, cannot determine the direction of thermodynamic processes. The generalization of the results of numerous experiments led to the conclusion about the impossibility of constructing a perpetual motion machine of the second type. This conclusion is called the second law of thermodynamics, which indicates the substantial difference between the two forms of energy transfer – heat and work. It states that the transformation process of the orderly movement of the body as a whole into the disordered movement of the body particles and environment is irreversible.

ENTROPY

The notion of *entropy* originated from the laws of energy conversion, indicating the function of the system state, whose differential in the elementary reversible process is the ratio of infinitely small amount of heat imparted to the system to the absolute temperature of the latter:

$$ds = \frac{\delta Q}{T}.$$

The entropy of a complex system is the sum of the entropies of all its homogeneous parts.

All actual processes are irreversible, so in reality, the entropy of an isolated system can only increase reaching the maximum in the state of thermodynamic equilibrium of the system. The mathematical record of the second law of thermodynamics:

$$ds \geq \frac{\delta Q}{T}.$$

The statistical interpretation of entropy is given by Boltzmann formula:

$$S = k \ln P + \text{const},$$

where S – entropy of the system; $W \cdot S$,
k – Boltzmann constant equaled to $1{,}38 \cdot 10^{-23}$ J/K;
P – thermodynamic probability of the state.

As a statistical law, the second law of thermodynamics expresses the regularities of random motion of a large number of particles that make up an isolated system.

ELECTRIC ENERGY

Electric energy of a charged conductor, also called its own energy, equals:

$$W_e = \frac{C\varphi^2}{2} = \frac{q\varphi}{2} = \frac{q^2}{2}.$$

where C – electric capacity of the conductor;
q – its charge;
φ – potential of the conductor.

Energy W released in the electric circuit during time t in the entire volume of the conductor equals:

$$W = J\,U\,t,$$

where J – amperage;
U – voltage drop in the conductor;
t – time, s.

The heat corresponding to this energy (in calories) is

$$Q = 0{,}24\,J\,U\,t\,.$$

This equation expresses Joule's law: the amount of heat emitted by current in the conductor is proportional to the amperage, time of its passage, and voltage drop.

MASS AND ENERGY RATIO

There is the universal ratio between energy and relativistic mass:

$$W = mc^2 = \frac{m_0 c^2}{\sqrt{1 - \frac{v^2}{c^2}}},$$

where m – relativistic mass;
m_0 – rest mass;
c – speed of light in vacuum

6
Conversion and accumulation of information

“Mechanical brain does not produce thoughts, the same way as the liver secretes bile that was claimed by former materialists, and does not release it in the form of energy, like muscles. Information is information, but not matter or energy. That materialism, which does not recognize this, cannot be viable at present” [Wiener N. Cybernetics or control and communication in animal and machine. Moscow: Soviet Radio, 1968. P. 201].

WHAT IS IDEA?

The founder of cybernetics and information theory states that information is different from matter and energy. But what is information then? This question makes involuntarily look at the centuries-long dispute between idealism and materialism and ask again and again the perennial question: “What is the idea?”

“In order to properly understand what the idea is, it is necessary to preempt one ambiguity. The fact that many are taking the idea for the form or difference in our thoughts and in this sense the idea is in our minds only to the extent that we think about it, and every time when we think about it again, we have different ideas about the same thing, though similar to previous ones”.

Those were the ideas of Gottfried Wilhelm Leibniz (1646-1716), one of the most remarkable thinkers, who left them to people now living on Earth. I am reading his articles in the first volume of the 4-volume edition of his works in Russian and thinking about the essence of the notion “idea”. What belongs to Leibniz in the book that I am reading? Blue binding of the cover? No, this is not his offspring. Ink? – It is not his as well. Paper? – No. The words? But I am reading the Russian text, but he wrote it in French and German. What is Leibniz’s then? Of course, Leibniz’s idea that has reached me, but already converted from one sign system to another one. Leibniz’s ideas about the essence of the notion “idea”! Well done! Leibniz already passed away long time ago, but I am reading and reasoning with him, arguing and trying to convince him that the idea is now called “information”, and many its types can be quantified.

“Stop, Stop”! – I hear Leibniz’s voice. “Please, read what I said about it then…” And indeed our soul always has the property to imagine whatsoever nature or form, when we have the reason to think about it. In my opinion, this property of soul, as it expresses some nature, form or essence, is actually the idea of a thing in us, and moreover always, whether we think about it or not. For our soul expresses God and Universe, as well as all essences and existence” [Leibniz G. W. Coll. Vol. V. 1. P. 151].

It follows from the above that soul is the reformer and spokesman of ideas, and spirit is the idea itself, which emerged from the soul. The soul disappears with the death of the body, i.e., the reformer and spokesman of ideas dies. The spirit-idea is eternal if the material (energy) carrier and reformer of these remaining spirit-ideas is eternal. It is no coincidence that Leibniz defines: “... those expressions, which exist in our soul, whether we imagine them or not, could be called ideas; but those that we do not imagine or form – notions (conceptus)” [Leibniz G. W. Coll. Vol. V. 1. P. 152].

MONAD, ENTELECHY

And then, quite noteworthy: “A body belonging to monad, which is its entelechy or soul, forms together with the entelechy what may be called a living being, and with the soul – what is called an animal” [Leibniz G. W. Coll. Vol. V. 1. P. 424].

Here we come across such notions as **monad** and **entelechy**. The development of modern scientific thought on cybernetics, information theory and its application in theoretical biology and social science strongly dictates to take a fresh look at the scientific heritage, some time ago referred to objective idealism as some hostile opposition of dialectical materialism.

But let us listen to Leibniz: “If the only difficulty you have, sir, is the assumption of the fundamental possibility of spontaneous movement of thoughts, I do not lose hope that someday it will become clear, because everything that is in action, is in a state of transition and continuation, and I know nothing in nature that does not obey this rule. Otherwise, where would changes emerge from?” Is it not dialectics? Let us follow Leibniz further: “The truth is that if they are deprived of this action, and, therefore, what follows the action or transition to other actions, I do not see what they will have at all... And if being distracted from this for all contributions and limited only by the relations of creations between each other, then all substances must have some tendency (to spontaneity), or rather, spontaneous movement. It is the force, or inclination, to which I cannot find better designation than *entelechy*, which has attracted so little attention so far; and in the meantime, there is nothing more significant and more noteworthy among all beginnings than this beginning. Although Aristotle gave this name to it, nevertheless, he, apparently, did not sufficiently understand its meaning, or, at least, did not sufficiently explain it. And since, as far as I know, it is assumed that soul has such spontaneity in some cases, the hypothesis that it will possess it in other cases becomes still more probable. But in fact, it is something more than the hypothesis – the same applies to the maxim, which I indicated in my essay that **“the present is always fraught with the future, in other words, at present every substance must express all its future states”** [Leibniz G. W. Coll. Vol. V. 1. P. 346].

Isn’t it dialectics? And isn’t here the beginning of phylogenetics and genetics in general – modern science of the regularities of heredity and variability of organisms, methods of controlling these processes? For how many years have we cursed Mendel and Morgan as sworn enemies of dialectic materialism?!

The founder of differential and integral calculus Leibniz was well aware of the need in quantitative representations of ideas, so he created the whole doctrine on monads – *monadology*, in its content it is the messenger of the modern information theory, its philosophical foundations.

Leibniz proposed the following: “...the primary driving force, which in conjunction with the length (or purely geometric element) always acts, although experiencing various changes in its aspirations and stresses as a result of collision of bodies, this is the substantial beginning called **“soul”** in living beings, in others – **substantial form**, and since it is really one substance with the matter or it is single by itself, it forms what I call **“monad”**, since if we remove these true and actual units, then there is no genesis in bodies apart from the compound one, and even, as it follows from this, no actual genesis” [Leibniz G. W. Coll. Vol. V. 1. P. 300].

Leibniz states that we can give the name of entelechies to all simple substances or created monads because they have a well-known perfection and have a self-sufficiency, which makes them the source of their internal actions and, so to say, bodiless automatons. But since a feeling is something more than mere perception, for simple substances with only perception the general names of monads and entelechies are enough. And only such monads whose perceptions are more distinct and are accompanied by memory can be called souls.

W. LEIBNIZ'S MONADOLOGY

The detailed study of Leibniz's theoretical heritage (though in Russian translation) from the standpoint of the current state of various rational sciences allows us formulating some basic conclusions.

1. Doctrine of ideas – it is essentially the doctrine of information processes.

2. Entelechy – a thinking organism with a body and soul created by the nature (by God).

3. Body and soul together become the vital activity form of the organism, which produces information.

4. As a result of vital activity, the living being leaves the genetic information (preformation by Leibniz).

5. Apart from hereditary offspring the thinking living being leaves its mind in the form of accumulated ideas in a variety of material and symbolic forms.

6. Ideas in the memory are the accumulated variety of monads, which can be called intelligence (thesaurus).

7. Ideas can be quantitatively expressed in terms of the unit of the process of generating ideas with the help of simple monads.

A. RENYI ABOUT INFORMATION

Leibniz's ideas are objectively reflected in the ideas of modern scientists, one way or another investigating information processes in a human body and society. Hungarian mathematician Alfred Renyi wrote in 1976: "I find it surprising that information bearing the distinct material nature, actually has properties similar to those of matter. Thinking about this, I decided that information, not being the matter, can exist only if it is tightly "tied" to the matter. Only the matter or entelechy (e.g. the electromagnetic wave) can always be the carrier of information, which, as the carrier of information, is included in the notion of matter. To fix the literal text, we write or print it on paper, cut out on a rock, etc. The sound, being nothing else than the vibrations of air molecules, can be fixed by recording it on a gramophone record or tape-recorder tape, etc. The transfer of information between two points located at large distance from each other can be effected either along wires by means of electric current or by means of radio waves. Of course, it would be nice to know how our brain is functioning, in what form the thoughts are represented in it and how they are stored in memory. Although not everything is clear to us in this area, we know one thing: thinking is closely related to chemical processes and electrical currents flowing in a material medium – in the brain matter. It follows that the data transmission rate cannot be arbitrarily high since it cannot exceed the speed of light" [Leibniz G. W. Coll. Vol. V. 1. P. 261].

And further A. Renyi develops the idea of finding energy and information interrelations. "I decided to ask whether philosophers know anything about the deep analogy between energy and information. I had a close friend, a serious philosopher. And I asked him this question. As I expected, the question arouse his genuine interest as energy and information play an equally important role in our lives. But my friend could not answer it candidly and promised to do it later.

However, his search did not bring any tangible results. First of all, he had studied works of classics of Marxism from cover to cover, then he had turned to Hegel, but found nothing. Somewhat frustrated by this bad luck, my friend stated that the solution of new problems should be sought not in the past but in the modern, new ideas.

Meanwhile, I was able to mentally go through almost everything related to energy and information transfer, and the analogies between energy and information began to offer themselves.

Let us take, for instance, such a wide, as it could seem, area as history. The history of mankind can be jokingly called the history of energy. The discovery of fire was of great importance. In order to keep and maintain fire, it was necessary to organize a group of people. The information transfer in the form of body language and speech became necessary. Therefore, it is possible to establish the link (although not too straight) between the discovery of fire and emergence of one form of information transfer. But let us move on. A human being mastered the simplest type of natural energy – wind, domesticated animals, developed shipping, agriculture. The development of transport and commodity production contributed to the emergence of a certain layer of talented people who were professionally engaged in the development of a new method of data transfer: art, painting, sculpture. A potter's wheel, driven in one and another direction by the leg power, pushed a potter's skills, and pottery works say much about the past (and present) of humanity.

One can see the parallel between the invention of the wheel, lever and other simple mechanisms and emergence of writing, between the invention of the steam engine and book-printing. And finally the most obvious example – the practical use of electric current led to the development, perhaps, of the most important devices for information exchange: telephone, radio and television.

I did not dare to show my parallels found to fellow historians. They would no doubt have found a lot of mistakes, would have pointed out the lack of credibility in my arguments. Nevertheless, there is something in the parallels that I noted. However, even if there is nothing in them, it is still clear that human development is closely linked not only with the development of certain types of energy and methods of energy transmission over distances, but also with the development of methods of information transfer. At first glance, it seems that there is no close relationship between the two greatest discovers of the recent past – nuclear energy and electronic calculating machine, but still it is clear that the discovery of a new energy source and creation of new processing facilities did not accidentally coincide in time.

Staying within the same range of issues, we should note that the level of economic development of a country can be almost certainly characterized by the amount of energy consumed. But another indicator – the amount of the flowing information, by which I mean everything from the latest news to economic information – just as clearly characterizes the level of development.

It is unlikely that someone will be surprised if I say that the parallels between energy and information can be also seen in biology. Living beings have the ability to convert one form of energy into another or substance (food) – into energy.

The higher is the level of animal development, the more ingenious and complicated is the problem of converting types of energy and substances into energy, being solved by its organism. But as far as we can see, the transformations of information in an animal organism are even more complicated. Even the simplest animals have the ability to find food with the help of the sensory organs and do not eat it before they transfer the information about their finding (for this, animals send signal movements in a certain sequence). For example, when entering the retina of an animal's eye, the information reaches the ultrasensitive element and from it the information goes into the brain along many tiny nerve fibers in a very interesting way (in the form of pulses of cell chemical activity). There the information is subjected to complex processing. Even the Pavlovian conditioning is a very complicated kind of information processing. I do not want to write how complex is the information processing in a human brain, for a Martian accidentally looking into my diary does not blame us humans of excessive self-esteem (although it is possible that his accusation is reasonable).

One more example from biology. Getting up out of bed, I have breakfast, i.e. I am getting energized (not because I am going to do it all day, but just because I am hungry). At the same time, I start reading a newspaper, and this activity absorbs me so much that sometimes I miss the mouth. This is nothing else but satisfying the hunger for information.

Normal functioning of not only all living beings but also any organization (whether mathematical society, factory, army, ant hill) is absolutely impossible without energy and information exchange. What can be said about the materiality of energy and information? The materiality of energy is indisputable, while the information by its nature is more related to the spiritual sphere. But how come? Isn't the materiality of information manifested in the fact that it can be transferred only by the matter (or energy) in the form of characters written on paper, electric pulses, etc. It came to my mind that there is a phenomenon in the field of telepathy, or, if we use a more scientific terminology, parapsychology, where the energy transfer occurs allegedly without the material carrier. But you cannot be sure if these phenomena definitely exist, and if they do, what are the features of their flowing. It is possible that matter and energy transfer takes place in them in some previously unknown forms, and then they are in contraindication with my ideas.

All this is true, but the same information can be transmitted in many ways, e.g., using newspaper and radio. Therefore, the information should not depend on its material carrier. Now everything is clear! Similarly it is with energy. Not the form, in which we get energy is sufficient, but its amount. From this point, there is a complete analogy between information and energy. That is why I wrote that, essentially, apart from energy carriers, there is only one number – the amount of energy. If we disregard material carriers of information, all information is stored as a whole, although the modern theory is dealing with studying only the quantity and not the quality of information.

We know about energy transformations, e.g., that energy does not disappear. I have been thinking for a long time that encoding the sequence signal, we essentially transform the information in the same way as the energy of falling water is converted into electricity. Is it true, at least in any sense, that the amount of information in such transformation neither increases nor decreases, and if it is true – in what sense?" [Renyi A. Trilogy on mathematics / Translation from Hungarian. Moscow: Mir, 1980. P. 274-278].

The whole history of the dispute between materialism and idealism, as can be seen from the foregoing two sources (V. Leibniz and A. Renyi, and some others can be compared), is reduced to the issue of energy and information (idea) interrelation.

THREE APPROACHES OF A. N. KOLMOGOROV TO THE NOTION "AMOUNT OF INFORMATION"

Here we come to the need for quantitative determinations of the notion "amount of information". At the time, academician A. N. Kolmogorov outlined three approaches to the definition "amount of information" [Three approaches to the definition of "amount of information". // "Problems of information transmission". Moscow: Nauka, 1965. V. 1. Iss. 1]. Before the release of this article, two approaches to the definition of this notion: combinatorial and probabilistic have been known. A. N. Kolmogorov introduced the third approach, which he called "algorithmic" using the theory of recursive functions.

The combinatorial approach involves a great number of variable signal values, and their "entropy" (state) is quantified through the logarithmic scale at the base equaled to 2 (two alternatives: "yes" or "no"). Removing the entropy in the perception of the multitude of variable signal values, we get adequate information on a logarithmic numeration.

Considering the actual processes of information transformation and perception, A. N. Kolmogorov found great difficulties in practical application of the combinatorial approach to determine the amount of information, thus, for example, he considered the evaluation of the entropy of Russian texts, which can be defined as sufficiently accurate translations of the specified text in a foreign language. Despite considerable difficulties, Kolmogorov optimistically considered the possibilities of applying the combinatorial approach to determine the amount of information in various information systems. “Quite natural – he pointed out – is the purely combinatorial approach to the notion “speech entropy”, if we bear in mind the assessment of speech “flexibility” – the index of branching of speech continuation possibilities with given vocabulary and given rules of turning phrases.

The probabilistic approach is natural in the theory of transmitting “mass” information consisting of a large number of unrelated or poorly related messages, subject to certain laws of probability, through communication channels. Practically, for instance, the question of “entropy” of the stream of congratulatory telegrams and throughput “capacity” of the communication channel required for their timely and undistorted transmission, can be considered properly raised in its probabilistic interpretation and common substitution of probabilities for empiric frequencies.

But what is the real sense, for example, to talk about “the amount of information” contained in the text of “War and Peace”? Is it possible to reasonably include this novel into the set of “possible novels”, and even to postulate some probability distribution in this set? Or should we consider some scenes of “War and Peace” as forming random sequence with rather quickly fading “stochastic bonds” after a few pages?

In fact, no less unclear is the fashionable expression “the amount of hereditary information” needed, say, to reproduce a cuckoo. Again, there are two possibilities within the adopted notion of probability. In the first option, the set of “possible forms” with nowhere taken from distribution of probabilities in this set is considered. In the second option, the characteristic properties of a species are considered as the set of loosely interrelated random variables. The observations based on the real mechanism of mutational variability can be indicated in favor of the second option. But these observations are illusory, if it is assumed that the system of coherent characteristic features of the species arises as a result of natural selection.

C. SHANNON'S BANDWAGON

The probabilistic approach to determine the amount of information is proposed by C. Shannon who developed the theory of information related to the transmission of signals via the communication channels, in particular, in order to increase the carrying capacity of telephone channels. Later, with the prevalence of logarithmic measures of quantitative assessment of information (Hartley's method) and theoretical versatility of C. Shannon's probabilistic method, experts from various scientific fields began to try C. Shannon's formulas in their researches to calculate the amount of information. Since there are no other quantitative methods to calculate the amount of information, the researchers found the quantitative confirmation even in those knowledge areas that are not amenable to probabilistic interpretation.

Seeing the rage of probabilistic approach, C. Shannon wrote the special article "Bandwagon", in which he warned about the specific nature of probabilistic approach to the determination of the amount of information and the need to apply it to such phenomena, in which the probabilistic nature of the phenomena was already studied and proved by statistic physics. We find the confirmation of C. Shannon's ideas in the warning words of academician A. N. Kolmogorov.

The American scientists Hartley and Shannon, introducing the combinatorial and probabilistic approaches to determine the amount of information relied on the essential notion of “entropy” introduced by Clausius into the thermodynamic theory of physics. If entropy is a quantitative measure of energy state, it generates information, which should have the direct quantitative bond with it. Therefore, C. Shannon called the proposed information measure as “negentropy”, which means – negative entropy. Consequently, information removes the system uncertainty and reduces the existing trend of entropy increase.

D. FELKER AND M. VOLKENSTEIN ON THE INTERRELATION OF ENERGY AND INFORMATION

In information theory entropy H is expressed in bits per 1 symbol, in thermodynamics – in joules per 1 degree of freedom. American scientist Felker, drawing an analogy between information and energy, calculated that the minimum energy equivalent of 1 bit of information is $0{,}114 \cdot 10^{-19}$ J. This is extremely important epistemological conclusion, because there is not only logical but also quantitative relation between energy and information.

Biophysicists performed studies on the same topic that prove the applicability of both thermodynamic indexes of entropy and quantitative definition of information to living organisms. It seems that one of the major researches in this area is the work by M. V. Volkenstein. Here is what he wrote: “Thus, the information entropy is equivalent to the thermodynamic one. One bit of information corresponds to

$$K \ln 2 = 10^{-23} \text{ J/K},$$

i.e. to a very small thermodynamic value. This equivalence has a real physical sense – for the information received you need to pay by the entropy increase. Any change is connected with the environment entropy increase. The entropic price of bit K ln2 is its minimum cost. When throwing a coin, one bit of information is reflected, but the entropy release caused by heating the coin when it hits the floor is much larger than K ln2. The coin can be arbitrarily large. The equivalence of information in bits and entropy in J/K is similar to the equivalence of mass and energy in Einstein's law:

$$m = E / C^2.$$

The above conclusion is a very important scientific conclusion for the evolutionary theory. **If Einstein's law makes "a bridge" between the substance mass conversion and energy conversion, Volkenstein's findings allow quantitatively linking the law of energy conversion and conservation with the law of information conversion and accumulation.**

Leibniz's philosophical reflections on monadology in connection with quantitative methods of physics, chemistry, biology and information theory can be interpreted through the corresponding quantitative mass, energy and information measures. **Maybe a monad is the unit that combines kilogram, joule and bit to quantify that manpower, the notion of which was quantified by Leibniz via $\frac{mv^2}{2}$.**

If so, the monad becomes the unit, which allows measuring the evolution of life and quantitatively representing the entelechy – intelligence. But here we come across the problem of measuring the information.

A. WILSON AND M. WILSON ON MEASURES OF INFORMATION QUANTITY

It is well known that a bit (binary digit) is the unit of information measurement. It is like an informative atom. It can be represented by one of the two digits of the binary number system – 0 or 1 – and it means such amount of information that is contained in the answers “yes” or “no” to any question about the object properties. Practical attempts to apply bits for the quantitative analysis of many issues raised by life were not successful. The probabilistic approach, as we see, is sometimes absurd even by the very nature of the phenomenon. In this regard, the measures of information amount, adequately reflecting the nature of the process, are being sought.

The observations of A. Wilson and M. Wilson on measures of the information amount seem very important. Here is what they wrote in 1955: “In order to measure the amount of information contained in the message or signal, you can use three different types of units: units of measuring uncertainty, structural complexity and accuracy”. In literature, most attention is paid to the first of these measures. As for the rest, they are almost never used.

MEASURE OF UNCERTAINTY

To measure the amount of information using the notion of **uncertainty**, experts in the field of information transmission consider the specific amount of information as the selection from the variety of possible alternative amounts of information. Thus, when casting the dice, the probability of getting 5 is 1/6, because the dice has only six faces. The considerable part of information theory is closely related to the probability theory.

The amount or scope of information in the message is determined by the number of bits in this message. The number of bits per time unit is called the bit rate. If there are multiple sources of information, the corresponding amounts of information are added.

MEASURES OF STRUCTURAL COMPLEXITY

Logon content is the number of logons in some representation. *Logon* is a unit of structural information, it means that it is possible to add one new distinguishable group or category to the existing representation.

The number of logons given by the device per volume unit of the coordinate space (cm, cm^2, sec., etc.) is called the logon power. For example, in case of microscope the logon power is the measure of resolution in logon/cm. In the time domain, the channel with the bandwidth that allows performing n independent counts in 1 sec has logon power $\frac{n}{c}$.

MEASURES OF METRIC INFORMATION

Metron is the unit of measuring the metric information. In case of numeric parameter, this unit is the measure of "precision", with which this parameter is specified. Each metric unit of information can be considered as the measure associated with some elementary event from the sequence of physical events that represent this object. Thus, the volume of metric information in one logon (metron content of logon) is defined by the number of elementary events, through the interaction or "condensation" of which it is formed. *Condensation* (Latin – condensatio) – thickening, accumulation, compaction.

These events are indistinguishable; their number is not the number of bits, to which 1 logon is equivalent. The accuracy increases monotonically with the increase in metron content, however, only a few characteristics are linearly connected with them. Power and energy in the classical sense are among these few exceptions. A number of metrons per single volume of the coordinate space is called the metron power or metron density of a physical system [Wilson A., Wilson M. Information, computers and system design. Moscow: Mir, 1968. / Translated from English. P. 62-63].

THREE ASPECTS OF INFORMATION

The above arguments are so important that further development of the information theory, regardless of them, cannot be fruitful, especially in the field of human communication. One cannot ignore the fact that the notion of information has now become universal and is the main notion of cybernetics; the same as economic information – the basic notion of economic cybernetics.

Based on the economic management needs and, consequently, economic cybernetics, the information can be defined as all data, knowledge, messages that help solving a particular management problem (i.e., to reduce the uncertainty of its outcome). Then, some possibilities for the evaluation of information open up: it is more useful, more valuable – the faster or with less losses it leads to the solution of the problem. The notion of information is close to the notion of “data”. However, there is the difference between them: data – are signals, from which it is still necessary to extract information. Data processing is the process of bringing them to the form suitable for extracting information.

The process of data transmission from a source to a consumer and perception as information can be considered as the passage of three filters:

1) **physical** or statistic (purely quantitative restriction on channel carrying capacity, regardless of the data content, i.e. in terms of syntactics);

2) **semantic** (selection of the data that can be understood by a recipient, i.e. they correspond to the thesaurus of his/her knowledge;

3) **pragmatic** (selection among the understood information only what is useful to solve this problem).

Accordingly, three aspects to study information problems are singled out – syntactic, semantic and pragmatic. By the content the information is divided into socio-political, socio-economic, scientific-technical, etc. In general, there are a lot of classifications of information, they are based on different grounds. For instance, the information is divided into statistical (constant) and dynamic (variable), and data, at the same time, are constant and variable. Another division – primary, derivative, output information; third division – managing and informative information; fourth – excessive, useful and false information.

GENERAL LAW OF INFORMATION CONVERSION AND ACCUMULATION

With all the interpretations of the notion of information, it assumes the existence of two objects: a source of information and consumer (receiver) of information. The transmission of information from one to the other takes place by means of signals, which, generally speaking, cannot have physical connection with its meaning: this relationship is determined by the agreement. For example, the clam in the assembly bell meant that it is necessary to gather on the square, but for those who were not aware of this rule it did not convey any information.

Regarding the valuation and usefulness of information for the recipient, there is still a lot of unsolved and uncertain. In recent decades, philosophers demonstrated a great interest in the problems of information: they tend to treat the information as one of the universal properties of matter related to the notion of reflection [Lopatnikov L. I. Brief dictionary of economics and mathematics. Moscow: Nauka, 1979].

We hold to the same opinion and assert that, along with the general laws of conversion and conservation of matter and energy, there is a universal law, which we formulate as follows: **information, which also undergoes transformations in the process is generated in the evolutionary process of the conversion of substance and energy, but unlike the substance and energy it is saved not only quantitatively, but also tends to accumulate. The tendency of information accumulation is a universal principle of evolution.**

Through the notion of reflection in the evolutionary process it is possible to connect another rather important notion – “complexity” with the notion of information. It is not by accident that academician A. N. Kolmogorov ultimately brought the proposed algorithmic approach to the determination of information amount to quantitative numeration of algorithm complexity. This is also attested by the notion of **logon** as the unit of measurement of structural complexity.

MATHEMATICAL SUMMARY

This summary has been prepared entirely on the basis of the chapter “Basic notions and ideas of information theory” from the book by A. Wilson and M. Wilson “Information, computers and design of systems” [Wilson A., Wilson M. Information, computers and design of systems. / Translated from English. Moscow: Mir. 1968].

An essential element of any mathematical model of any system is the **mathematical description of information as the energy alternating flow**. Unfortunately, there is still no satisfactory “system information theory” in literature. Therefore, it is not only desirable, but also very important to have the information theory specifically adapted to the systems. Currently, there is the well-developed “information theory”, which serves the objectives of the research of problems in communication theory.

Shannon’s model of communication system contains the following five parts:

1) “Information source”, which produces messages or sequences of messages.

2) “Transmitter”, or “encoder”, which converts messages generating signals suitable for transmission along the channel.

3) “Transmitting channel” (often referred to simply as “channel”) serving to transmit signals from the transmitter to the receiver (for example, a pair of wires, the bandwidth allocated to this radio station, etc.).

4) “Receiver” or “decoder” that performs the inverse functions compared to those of the transmitter, restoring the original message by the signal.

5) “Destination” – a person (or object), to which the message is intended.

This model (sometimes slightly modified) is almost always taken as the basis for study in the works on the information theory.

Two important results were obtained in 1920-s: Nyquist sampling theorem and the ratio between the bandwidth and time interval found by Hartley.

Sampling theorem. The known Nyquist sampling theorem states that the arbitrary function of time f(t), the spectrum of which is limited by the band from 0 to W Hz, is fully restored, if you set its values at discrete points of time, the number of which within the length interval T is 2 T W. In other words, the function values are set at points located at the distance of 1/2 W from each other. The foregoing makes sense for any function, wherein Fourier transform apparatus is applied.

Hartley's theorem. Hartley found that the amount of information that can be sent along the channel with bandwidth W during time T is proportional to

$$2\,W\,T\,\log S = \log(S^{2WT}),$$

where S – number of distinct signal values (e.g., values of amplitude, frequency, power).

Thus, for transmitting the predetermined amount of information it is necessary to have a certain value of the product of bandwidth by the time interval.

The amount of information is measured by the following value:

$$J = \log N,$$

where N – number of different choices.

The unit of information amount corresponding to one binary choice is called **a bit**.

Uncertainty principle. Gabor set "uncertainty principle" based on the inverse relation between the signal duration and effective bandwidth of spectrum. In the band of variable signals with limited bandwidth ΔW only the signal with the duration not less than ΔT can be measured, so

$$\Delta W \cdot \Delta T \approx \text{const} \approx 1.$$

The exact value of the constant depends on the arbitrary determination of ΔT and ΔW. Gabor compared this property with Heisenberg's uncertainty principle and showed that some mathematical ideas of the quantum theory can be also applied to the study of signals. Of course, not the quantum theory itself is applied, but only some of its mathematical methods.

Problem of communication theory. Information theory considers the main communication problem consisting in the exact or approximate reproduction of the message in some point (or points) selected in another point. The word "chosen" has an important meaning, since it is assumed that a particular message is the selection result of a set of messages. When the message to be transmitted should be uncertain in advance and, hence, unpredictable: if it was known in advance at the receiving end, then when the message was received, we would not get any information. The amount of information contained in the message depends on the information uncertainty.

Brillouin formulates this central task of information theory as follows. Let us assume that there are many possible events, the accident probability of which equals P_1, P_2, ..., P_i, ..., P, respectively, of course, every $P_i < I$ and $\sum_{i+1}^{n} P_i = I$. The communication system needs to work correctly for any choice of a specific message from the set of all possible messages. This condition determines the required properties of the channels, as well as the properties of the receiving and transmitting devices.

In many practical cases, the information has to be transmitted in the presence of noises or other disturbances. In this case, the receiver does not always reproduce what has been transmitted. In order for the system to work satisfactorily, the level of noise and other disturbances has to be within acceptable limits.

Shannon's model for discrete signals. Shannon summed up Hartley's idea about the information amount. Shannon suggested that there is a discrete source of messages generating information in the form of sequence of characters. In the source successive signs are chosen in accordance with certain probabilities, in general, depending on the previous choices. The physical source of messages (or its mathematical model) is called a random process. In mathematics we study a special class of random processes generating discrete sequences with a finite number of possible values. This class of processes is called discrete Markov processes: discrete because we consider discrete sequences of characters; Markov – named after the scientist A. A. Markov who studied these processes for the first time.

Markov process (or chain) describes the system behavior, which can be available in several states: P_1, P_2, ..., P. If the system is in P_a state, the probability of its transition to P_b state is set by the probability of transition P_{ab}. Markov processes are found in many areas not related to information theory: in biology, genetics, etc.

The output signal at the given time depends both on the current state and input character arriving at this moment. The next state is another function of these variables. Thus, the information converter can be described by the equations:

$$x_n = \mathrm{f}(u_n , a_n), \quad a_{n+1} = g(u_n , a_n),$$

where u_n – n^{th} input symbol;

a_n – converter state at the moment when signal u_n arrived;

x_n – output character (or sequence of characters) produced at the moment when signal u_n in state a_n arrived.

In the above coding model, the characteristic indicated by Shannon with symbol H, in a sense, is the information measure produced by ergodic process. For this process

$$H = -K \sum_{i=1}^{n} P_i \log P_i,$$

where P_i – probability of the i^{th} state;

K – positive constant, which determines the measurement scale.

Function H has the same form as entropy H in Boltzmann's theory, which states that for any initial distribution the entropy must increase until it reaches the statistical equilibrium characterized by the maximum possible value of the entropy.

Entropy of any system is a measure of "disorder" in it. It always tends to increase. Information is also a measure of order. Hence is the minus sign in the formula.

EFFICIENCY AND REDUNDANCY

The ratio of true value of *H* to the maximum possible value for the same form of signals is called the relative entropy, or the efficiency of *E*.

$$E = \frac{H}{H_{\max}} = \frac{\sum_{i=1}^{n} P_i \log P_i}{\log m} \leq 1.$$

Redundancy is a property of languages, codes and sign systems, consisting in the fact that a message contains more signals than is actually required for the transmission of information. Redundancy is quantitatively expressed by the formula:

$$\text{Redundancy} = 1 - E\ .$$

This property improves communication in noisy environments but it should not be excessively used, since the more is the redundancy, the lower is the efficiency.

The measurement of information amount is sufficient when designing any measurement system, any system of data transmission, and, in general, any automatic system. However, we should make a caveat. There is no yet entire general theory of information.

Finally, the notion of information as a form of variable energy is important for all professionals dealing with system design. With the help of this notion Felker demonstrated that information, like other forms of energy, also has the quantum nature.

Apparently, Shannon’s conclusion that the converter can, at best, preserve the input entropy, has far-reaching implications. Of course, this conclusion is true for any device. Is it true for a human being? If so, what does it mean? If not, why not? All these are important philosophical questions.

7
Problems of measuring complexity

Having considered the information aspects of evolutionary development, it is necessary to refer to the category of complexity, arising directly from the information theory. It is conventional to speak about the increasing complexity of systems in the course of evolution. No matter how we determine complexity, it is clear that a multicellular organism is more complex than a single-celled one, that a human being is by many orders more complicated than a blue-green algae. However, science requires stricter definitions, and practice – relevant measuring instruments.

PHILOSOPHY OF COMPLEXITY

A fairly complete philosophical understanding of complexity was given about forty years ago by B. V. Biryukov and V. S. Tyuhtin [Biryukov B. V., Tyukhtin V. S. On the notion of complexity // "Logic and methodology of science". Moscow: Nauka, 1967. P. 218-225]. We give it with some reductions.

The notion of **complexity, complex system, complex situation**, etc., intuitively clear in everyday experience, is unclear and uncertain, refuses to "work" as soon as the problem to study complex systems with precision methods arises. It appears particularly acute when studying the structure and operation of such complex systems as large industrial complexes, economic systems, different unions of people, living organisms, brain, etc. The notion of complexity has acquired a special part in cybernetics, the predominant goal of which is to develop methods of analysis and synthesis of complex dynamic control systems. Cybernetics is a rich source of material having a close relation to the notion of complexity.

We encounter the notions of complexity and complex systems in everyday practice and, in fact, in all sciences. Complexity is a general scientific notion, by its “status” approaching the philosophical category, and this makes topical the methodological analysis of this notion.

On two sides of complexity notion. Two sides can be distinguished in scientific notion: the objective aspect of the notion conditioned by the object displayed in this notion, and “the subjective” aspect of the notion. In the latter case, we mean not the distorted reflection of reality but not subjectivist interpretation of knowledge results, and the specific ways of existence of this notion in the framework of knowledge on the given development level of the latter, ways of expression of the objective content of the corresponding notions in human cognition.

Objective and subjective aspects of notions are usually tightly fused, and the distinction between them requires the use of appropriate abstractions. For instance, in the notion of “simple” reason (some event) we abstract not only from the set of “external” actions on the object under study, but also from the reverse effect of the object, which is the carrier of “consequence” against its “cause”.

In the notion of complexity, the objective aspect of the notion is conditioned by the increase (compared with the usual, “uncomplicated” systems) in the number and varieties of elements (subsystems) of systems (certain classes), links between elements or subsystems, their properties, etc.

To the subjective aspect of the notion of complexity we can refer original abstractions and assumptions, theoretical methods and technical capabilities needed to display this complex system, as well as the difficulties and limitations in its adequate representation, which we face under the given conditions of its knowledge. At the same time, the feature of the complexity notion is just that "the subjective" aspect is most clearly expressed in it.

COMPLEXITY AND RELATED NOTIONS

When does it become necessary to use the terms "complex system", "complex object"? What are the objective and subjective components of the notion of complexity?

The need for the notion of complexity arises, first, when we move from the consideration of **the simple** we come to **the composite** – to some aggregate consisting of (simpler) elements.

Further, the notion of the complex arises naturally when we move from the consideration of **parts** (and their properties) to the consideration of **the whole** formed with the help of certain relationships between the parts regulating the parts into the system, which is marked out with functionally inherent ways of behavior and often also spatially.

But the object appears as the simple or a part in relation to another specific object – a composite object, the whole. For example, the cell in relation to the organism is a part, and in relation to its constituent molecules – the whole. In principle, any object can act as a (relatively) simple or (relatively) complex.

In the outlined above two paragraphs of the introduction of complexity notion that are very closely related to each other, we can see the link between the system **complexity** and the notions of its **organization** and structure.

The notion of complexity introduces only the first approach to determining the level of organization of the systems being compared, to searching for their organization criterion. By itself, the knowledge of the number of elements, connections between them and properties of the system and its subsystems do not yet allow one to solely characterize the system organization. There is a close relationship between the notion of complexity and organization in any of the reasonable clarifications of these notions, the nature of which we do not discuss here.

The notion of complexity is also close to the characteristics of objects, such as their **diversity** and **heterogeneity**. Indeed, under otherwise equal conditions, it seems natural to consider the object the more difficult, the more is its variety. The latter notion can be regarded as characterizing one aspect of the **formation** or **structure** of the system. Hence is the link between the notion of complexity and the notion of structure and the ways of representing the structures of objects and their behavior. In the cognition, we often come across such situations when the former properties of the research appear ineffective, and the complexity serves as a measure of difficulties associated with the search for new means. It immediately raises the difficulty associated with the separation of the objective side of complexity from “the subjective”, stemming from the accepted way of describing the object, with the separation of content from the form of its expression.

The above explains the topicality of developing the ways to evaluate the system complexity, to define the reasonable criteria for these evaluations. The evaluation of the system complexity allows for theoretically and (or) practically suitable choice among the existing research methods, to develop new methods, to predict general behavior features of the systems, etc. Of particular interest is the case when the investigated object is treated as “a black box”, as the system, where the internal structure is unknown, but which (system) allows, considering its “inputs” and “outputs”, to assess its “external” (functional, from the point of behavior) complexity.

ON CRITERIA OF COMPLEXITY

The important step in analyzing the notion of complexity is connected with revealing the fact that different types (classes) of systems (or their structural levels) have distinctive features. These features are expressed, in particular, in the difference of the laws of construction and operation of various systems and in the availability of different techniques (methods) of their investigation. The complexity of the two compared similar systems can be evaluated by well-defined (common for both systems) properties. At the same time, the complexity of systems in relation to **different** properties can be not the same (e.g., it can be different in relation to macro- and microproperties of the system).

In the theory of complex (large) systems or system engineering, the most important task is to develop methods for **simplifying** systems, i.e. practically acceptable reduction of the complexity of systems at their description. The system is divided into separate blocks, the operation of which is standardized and which can be studied independently of other blocks. Certain limitations are imposed on the links between the blocks and between the blocks and environment, e.g., related to the number of communication channels between the blocks, etc.

The crucial role here belongs to the methods of information theory. The amount of information serves as a measure of the system diversity, or the measure of its heterogeneity. A. N. Kolmogorov directly links the notion of complexity with information.

FEATURES OF COMPLEX AND HIGHLY ORGANIZED SYSTEMS

To adequately describe the complex systems such as a living organism, society and their various subsystems, “ordinary” mathematics is of little use. Methods of mathematical analysis, developed mainly under the influence of problems of mechanics, physics, engineering are not sufficiently effective when investigating complex systems in cybernetics, biology, sociology. Therefore, the problem of developing mathematical methods appropriate to these systems is topical in mathematical cybernetics.

When searching for these methods, first of all, we take into account the essential features of complex systems. Let us mark some points that are essential for any brain-like systems and important to search for the mathematical methods to describe them and ways of their technical modeling.

1. High dynamic stability of brain functioning, high plasticity, adaptation to different operating conditions.

2. Combination of the principle of high ordering of deterministic type with probabilistic principle of brain-like system operation.

3. Optimal combination of discreteness and continuity in the operation of various complex systems.

4. Problem of appropriate selectivity, selectivity of the system in information processing.

5. Binary logic and deterministic algorithms are only the surface of our thinking. Apparently, the remark by

A. N. Kolmogorov that we underestimate the role of subconscious, activity of the brain subcortex and its influence on our conscious thinking is true. Probably, such complex and highly organized systems, such as brain, work basically following some “grey” (but not “black and white”) logic, with extensive use of algorithms with probabilistic selection of steps. Apparently, in the field of logic (the same as in physics) new, radical (“crazy”) ideas – ideas that will allow taking a significant step forward, are required.

6. This feature refers to the problem of searching, sorting out. Systems like the brain, can reduce the search scope through the development of new hypotheses, setting up new problems, changing the search direction, etc.

7. High reliability of complex systems associated with the redundancy of their construction (e.g., redundancy in copying information, in communication channels, in carrying out transformations, etc.), with compensatory ability (e.g., the brain is able to compensate for the disturbed functions, to replace functions, etc.) can be considered as their peculiarity.

8. This feature of complex systems is related to the nature of natural processes implementing the operation of complex systems. Perhaps, the approach of material used by a human to the living (or life-like) substrate will allow synthesizing opposing properties (rigidly deterministic and probabilistic, discrete and continuous action principles) required to implement the functions specific to highly complex systems.

MEASUREMENT UNIT OF COMPLEXITY

The world around a human being is infinitely complex. Everything is only simple for God. Therefore, to quantify the complexity it is necessary to define the simple as the reference point, as the measure of complexity. We have already discussed the measures of information amount: *bit* is a measure of uncertainty; *metron* is a unit for calculating metric information; *logon* is a measure of structural complexity.

To evaluate the complexity of any phenomenon, some perceiving subject is required, otherwise nobody can estimate this complexity. Perception is a process of the relationship between the perceptive subject and the perceived object. This process involves material and energy factors that give rise to mutual information. Consequently, the periods of reception, comparison (processing), sorting out (storage) and transmission of information can be singled out during the perception process. Thus, in every perception process (reflection) there is a specific algorithm, which contains both deterministic and probabilistic (uncertain) moments of transition from one algorithm member to the next one.

Proposing the algorithmic approach to the definition of the notion "amount of information", A. N. Kolmogorov identifies the information and complexity. He asserts that essentially the notion of information amount "in something" (x) or "about something" (y) is the most meaningful. No coincidence that in probabilistic approach it is generalized for continuous variables, for which the entropy is infinite, but in a wide range of cases it is finite. Real objects subject to our study are very (infinitely) **complex**, but relations between the two separately existing objects are exhausted at their simpler schematized description. If the geographic map gives us considerable information about the area of the earth surface, the microstructure of paper and ink printed on paper does not have any relation to the microstructure of the depicted area of the earth surface.

In practice, we are mostly interested in the amount of information in the individual object *x* with respect to the individual object *y*.

In this approach, it is very interesting to explore how metron, bit and logon are interconnected. The challenge is to find such mathematical function, which will monotonously increase with the improvement of accuracy of calculations and would allow quantifying all the information in the form of complexity, including calculus of metrons, calculation of information in bits and counting the number of structural components.

VARIETY OF SENSE ORGANS

But we will continue discussions about simplicity. At the beginning of this section we referred to God, saying that everything is simple for him: he decided and created Man who, now being the subject in reflection processes, suffers searching for the unit of simplicity and complexity. The measurement unit can be found in the human, taking him as created by the nature: without glasses, without a hearing aid, without thermometer, without a watch, without scales, without a meter, without a kilogram, without a second, without clothes, without accommodation, without words, only with the senses provided by the nature.

The nature provided the human with certain sense organs to perceive the external environment, internal generalization of reflected properties and response to the environmental action. Let us consider him in this natural simplicity and list all various sense organs:

1) sense of sight carried out by eyes that see seven colors of rainbow;

2) sense of hearing carried out by ears that hear the succession of seven sounds;

3) sense of taste, from sweet to bitter and from sour to lenten, carried out by tongue;

4) sense of smell carried out by nose with different vehemence;

5) sense of touch carried out by skin from hot to cold and from soft to painful;

6) sense of space carried out by all system of sense organs, in particular, by eyes, ears, and skin and pelage;

7) sense of gravity carried out by the whole organism in the gravitational field, in particular, the vestibular apparatus;

8) sense of time carried out by the whole organism, in particular, metabolic process (nutrition, hunger, tiredness).

Thus, the subject perceiving the external world with eight measuring "instruments" of various properties of objects: color, shape, sound, taste, smell, pressure, temperature, weight, duration is in front of us. Each natural measure has its own measuring scale, and the nerve system with the head center (brain) is the generalizing, making decisions device. A human being (not the corpse) continuously receives and accumulates information of eight different types, i.e. his perceiving sachet continuously transmits eight different signals. We will call this sachet – **quantum of information**. Each of the eight signals has its uncertainty (entropy), each of them records accuracy (metrons) in its metric scale, each of the sachets (quanta) of information has its logical complexity (logons).

MATHEMATICAL SUMMARY

Let us try to imagine the above observations in quantitative mathematical expressions.

The series of natural numbers – 1, 2, 3, 4, 5, 6, 7, 8, ... , n, where $n \to \infty$, – an infinitely large value.

The series of numbers – $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, ..., \frac{1}{n} \to 0$, where $\frac{1}{n} \to \infty$ – infinitely small value.

In the series of the ratios of natural numbers $\frac{1}{1} = 1;\ \frac{2}{2} = 1;\ \frac{3}{3} = 1;\ \frac{4}{4} = 1;\ \frac{5}{5} = 1;\ \frac{6}{6} = 1;\ \frac{7}{7} = 1;\ \frac{8}{8} = 1;\ ...\ ;$ $\frac{n}{n} = 1$ – any number can be taken as the reference point, for the base point of measurement.

For the transition from the reference point to the next number of natural series, it is necessary to add one to each subsequent number:

$$1 + 1 = 2 + 1 = 3 + 1 = 4 + 1 = 5 + 1 = 6 + 1 = 7 + 1 = \\ = 8 + ... = n + 1.$$

Between each natural number we can define an infinitely large number of infinitely small increments:

$$1 + 1 = 2 = 1 + \frac{1}{1} = 2 = 1 + \frac{1}{2} + \frac{1}{2} = 2 = 1 + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 2 =$$

$$= 1 + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = 2 = 1 + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = 2 =$$

$$= 1 + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = 2 = 1 + \frac{1}{7} + \frac{1}{7} + \frac{1}{7} + \frac{1}{7} +$$

$$+ \frac{1}{7} + \frac{1}{7} + \frac{1}{7} = 2 = 1 + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = 2 =$$

$$= 1 + \sum_{1}^{n} \frac{1}{n} = 1 \text{ where } n \to \infty \text{ and } \frac{1}{n} \to 0.$$

Hence it follows that $\sum_{1}^{n} \frac{1}{n} = 1$, i.e. the infinite sum of infinitely small values equals 1.

To shift from the reference point to the next number of the natural series, it is necessary to add the infinitely large sum (n) of infinitely small increments $\left(\frac{1}{n}\right)$ to the reference point.

The series of numbers $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8} =$ $= 2{,}72 + \frac{1}{9} + \frac{1}{10} + ... + \frac{1}{n} \approx 16 \approx e^{a}$ is the series of numbers tending to const for t $n \to \infty$ and $\frac{1}{n} \to 0$.

The series of numbers that make up the product 1 · 2 · · 3 · 4 · 5 · 6 · 7 · 8 = 40320 · 9 · 10 · ... · n = n! $\to \infty$ where $n \to \infty$ is the factorial quantitatively expressing the maximum possibility to different placements without repetitions of n elements by n, i.e. n! is the permutation of n elements.

The sum of numbers

$$\left(1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \frac{1}{5!} + \frac{1}{6!} + \frac{1}{7!} + \frac{1}{8!}\right) = 2{,}71824732... +$$

$$+ \frac{1}{9!} + \frac{1}{10!} + \frac{1}{n!} = 2{,}718281828...$$

The limit of expression $\left(1 + \frac{1}{n}\right)^{n}$ = 2,718281828... where $n \to \infty$ and $\frac{1}{n} \to 0$. From this we see that the limit of infinitely small increments to the reference point, repeated the infinite number of times, cannot reach number 3.

There is number n in the foregoing expression of the limit, which in its sequence repeats the series of natural numbers. Each number from n series can be represented as the degree fixed number, i.e.

$$n = a^k \text{ and } \log_a n = k .$$

If $n \to \infty$, when a = const $k \to n \to \infty$.

From the information theory, as demonstrated above $J = \sum_1^n P_i \log_2 P_i$. In this expression, the probability of random event i of n samples $0 \le P_i \le 1$. Consequently, we can represent $P_i = \frac{1}{n_i}$. When $n \to \infty$ P_i tends to $\frac{1}{n_i} \to 0$, and $\log_2 P_i = \log_2 \frac{1}{n_i} = \log_2 1 - \log_2 n_i = -\log_2 n_i$. If $n \to \infty$, then $\log_2 n_i \to \infty$, and here we have the same infinitely large value with the minus sign. These arguments suggest that when replacing the number n by expression $n\sum_1^n P_i \log_2 P_i$ we have

$$\lim \left(1 + \frac{1}{-\sum_{i=1}^{n} \frac{1}{n_i} \log_2 \frac{1}{n_i}}\right)^{-\sum_{i=1}^{n} \frac{1}{n_i} \log_2 \frac{1}{n_i}} = 2{,}718281828...$$

where $n \to \infty$, $i \to n$, $\frac{1}{n} \to 0$, $\sum \frac{1}{n} = 1$.

Let us show once again that with the above restrictions the discussion on the equality of two limits is correct:

$$\frac{1}{n_i}\log_2\frac{1}{n_i}=\frac{1}{n_i}(\log_2 1-\log_2 n_i)=\frac{1}{n_i}(0-\log_2 n_i)=-\frac{\log_2 n_i}{n_i};$$

where $n_i \to \infty$ $\log_2 n_i \to \infty$ and $\lim\left(-\frac{\log_2 n_i}{n_i}\right)\approx -1.$

The sum $-\sum_{i=1}^{n}-\frac{\log_2 n_i}{n_i}=\sum_{i=1}^{n}\frac{\log_2 n_i}{n_i}=n\to\infty.$

8
Information as reflected complexity

According to literature sources known to us, the identity of two above limits was not previously considered. Apparently, life did not require such comparative observations and calculations from mathematicians. The calculations here were presented in the report by Yu. S. Perevoschikov at V All-Union Symposium in Kiev on December 16-20, 1984 dedicated to the problems of creating converters of the information form. The organizers of the symposium were: State Committee of the USSR on Science and Technology, Soviet National Committee of International Association of Mathematical and Computer Simulation (JMACS), Scientific Council of Academy of Sciences of the USSR on Complex Problem “Cybernetics”, V. M. Glushkov Order of Lenin Institute of Cybernetics, Ukrainian Academy of Sciences. Below is what was noted in my report entitled “Information as reflected complexity”.

NOTION OF SYSTEM

Numerous publications of the results of philosophic-cybernetic and physical-mathematical studies allow asserting that in addition to the basic laws of substance mass and energy conservation and conversion there is the universal primary law, which we have formulated as **the law of information transformation and accumulation**. Three basic laws in totality allow quantitatively describing any controlled movement.

In the science of management there are different definitions of the notions “system – information”. We put forward the following definitions: **system is the set of elements interconnected in such a way that the action of the external environment (elements of the other set) to any part of them leads to the change of state in all the set; information is the reflected complexity**. The definitions formulated in this way, assume the process of reflection, which contains both the reflected object and the reflecting subject. At the same time, the reflection process acts as the process of learning and controlling the object, and, therefore, the information quantitatively reflects the control complexity, which is based on the laws of necessary diversity and accumulation of experience, being the fundamental laws in cybernetics.

In turn, the cybernetic approach to the system control makes it necessary to quantify the information. From the definition of information it follows that $J = \mathrm{f}(C)$, i.e.: information is a function of complexity. To quantify the information there are three different types of units in science: units of measuring uncertainty, structural complexity and accuracy.

To measure the amount of information using the notion of uncertainty, experts in the field of information transmission consider the specific amount of information as a selection from a variety of options (alternatives). The unit of structural information – logon, which means that you can add one new distinguishable group or category to the existing representation, is proposed as a measure of structural complexity. Metron is proposed as the unit of measuring metric information. In the case of numeric parameter, this unit is a measure of “precision”, with which this parameter is specified. The amount of metric information in one logon (metron content of logon) is determined by the number of elementary events, through the interaction or “condensation” of which it is formed. Here the condensation means concentration, congestion.

INTERPRETATION OF THE SECOND REMARKABLE LIMIT

Based on the above definitions of the measures of information amount we made an attempt to clarify the possibilities of applying the indicated measures to quantify the complexity of some reflected object (controlled event). For this the variety of known remarkable limit is proposed:

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^{n} = 2{,}7182...$$

$$\lim\left(1+\frac{1}{-\sum_{i=1}^{n} P_i \log_2 P_i}\right)^{-\sum_{i=1}^{n} P_i \log_2 P_i} = 2{,}7182... \text{ where } \begin{cases} n\to\infty \\ i\to n \\ P_i\to 0 \\ \sum P_i = 1 \end{cases}$$

There is no need for the mathematical proof of the identity of the given limits. It is important to point out the remarkable feature of the applied nature of the proposed variety of the limit. From the definitions of measures of information amount it is seen that events, messages, objects, processes of information in bits, metric information in metrons and structural information in logons are interconnected and, apparently, quantitatively mutually translatable, therefore, metrons have uncertainty in bits, logon has metron content.

QUANTUM OF INFORMATION

Let us assume that to the available representation expressed by one (1) we add the additional distinguishable group $\frac{1}{-\sum_{1}^{n} P_i \log_2 P_i}$ and we will repeat such indefinitely small addition n times. An indefinitely large number of repetitions of reflection processes will not increase the initial representation with the constant reflection method over e = 2,7182 ... times. Let us take i = 1,2,3, ..., n – number of metrons in the reflection process, $P_i \log_2 P_i$ – amount of uncertainty in bits, and the proposed kind of the remarkable limit – the number of logons in this representation being the result of the single reflection process of an object.

The indicated limit is the number e = 2,7182 ..., we can take it for the measuring unit of reflected complexity, i.e., for **the quantum of information**. On the basis of this statement we can conclude that the complexity unit equals e logons.

UNIT OF COMPLEXITY

The structure of any reflected object consists of a certain number of features N distinct for the given reflection method. Then, based on the above, we can write down the complexity expression in the form of the mathematical ratio:

$$C = K \ln N = e^x \ln N \quad \text{or} \quad C = \frac{\ln N}{e^{1-\varepsilon}},$$

where K – characteristic of the reflection way;

N – amount of features of the reflected object various at the given reflection method;

x – degree of gaining the experience in the reflection process;

ε – heuristicity level of the reflection process algorithm.

Thus, the derived complexity formula is a quantitative characteristic of the reflection process performed following the laws of the necessary diversity and accumulation of the experience; in a broader sense, the complexity formula quantitatively reflects the law of information transformation and accumulation (reflected difficulty). The formula proposes one possible way for the development of the general theory of measuring complexity of the systems. Thus, the methods for calculating the complexity of machine design, methodology for determining the complexity of the individual labor processes, methodology for calculating the complexity of the body geometry were developed and practically tested.

BIOPHYSICAL REPRESENTATION OF INFORMATION AND COMPLEXITY

Eight different human senses send signals to his brain. The combination of these senses creates the metronic field of $8! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 = 40320$ metrons. If we assume the appearance of all metrons as equally probable, at every moment they remove the uncertainty from the external environment, change its entropy: $\log_2 40320 = 15,3 \approx \approx 15$ bits. The human nerve system and brain perceive the information (reflect the part of indefinite complexity of the environment) that equals

$$\left(1+\frac{1}{-\sum_{1}^{8!}\frac{1}{40320}\log_2\frac{1}{40320}}\right)^{-\sum_{1}^{8!}\frac{1}{40320}\log_2\frac{1}{40320}} = 2{,}5848\ldots\text{logons.}$$

This value is significantly less than e = 2,71828182 ... logons. The efficiency of equally probable selection of metrons is less than the unequally probable (random) selection of metrons and it is

$$E = \frac{H}{H_{\max}} = \frac{2{,}5848\ldots}{2{,}71828182} = 0{,}951.$$

If in one single cycle of information perception the human organism in healthy condition (not blind, not deaf, not sick, etc.) ideally accumulates 2,71828182 ... logons of structural complexity (logical information), then the complexity unit is:

$$1 \text{ complexity unit} - C = \frac{\ln N}{e^{1-\varepsilon}} = \frac{\ln 15}{e^{1-0{,}0038}} = 1{,}000028 \approx 1.$$

Thus, we propose the unit of perception complexity, where there are seven signal-sense channels with an alternative choice of metrons “Yes”, “No” and one sense – time, which is essentially irreversible and valid only in the sense of “Yes”. Therefore, the quantum of information complexity contains 40320 metrons, 15 bits of negentropy, 15 different simultaneous signals at a level of indeterminacy (mismatch) of the perceiving system and, perhaps, efficiency coefficient

$\eta = 1 - \varepsilon = 0{,}9962$. Indeterminacy factor $\varepsilon = 1 - \eta = 0{,}0038$ is obtained from the following calculations:

$$\ln 15 = 2{,}708050201..., \quad e = 2{,}71828182....$$

The ratio $\ln 15 / e = 0{,}996235995...$. We take this ratio for efficiency $\eta = 0{,}9962$, and, hence, indeterminacy (mismatch) factor

$$\varepsilon = 1 - \eta = 0{,}0038.$$

Completing the consideration of the problems of quantitative representation of complexity, we give a number of arguments of biophysicist M. V. Volkenstein [Volkenstein M. V. Biophysics. Moscow: Nauka, 1988. P. 564-573].

The biological development, both ontogeny and phylogeny, proceeds in the direction of increasing complexity of the biological system. The complexity increase means the increased number of different elements of the system and bonds between them. The indispensability of the system elements is increasing, and, hence, the information value. One might think that the biological development should cause the increase in the information value, i.e., indispensability of the message elements at the simplest structure molecular level.

In the course of biological evolution, not only the value of information present in the organism increases, but also the ability of the biological system to select the valuable information. This ability reaches the highest level in higher animals, whose sense organs are designed for such selection. A frog reacts only to a moving insect, a bat using ultrasonic echolocation perceives only reflected but not direct signals. The selection of valuable information is the basis of all human creativity.

For one bit of information you need to spend energy not less then $k\ T$ ln2. This value is the price of one bit of information, both valuable and invaluable, inessential. The selection of valuable information does not require additional energy expenditures. It is sufficient, for example, to have such channel device in the receptor cell membrane for molecules or ions of specific shapes and sizes to pass through it. Energy costs associated with the creation of specialized channels or the membrane receptor regions, were incurred before in the earlier stages of biological evolution.

Thus, the living system is able to select the valuable information without paying a special "fee" for it. In other words, the living system of development approaches the state, in which it "pays" $k\ T$ ln 2 for one bit (and perhaps for one quantum?) of valuable information and "pays" nothing for imperceptible information, devoid of values.

Information representations will be undoubtedly useful in the present development of evolution theory. The appearance of protein in the dawn of life meant the creation of new information. As it follows from the neutral theory, the protein structure, in general, is initially the memorizing of random selection. With further "editing" the true evolution of the protein active part took place. It should be pointed out that in many cases the important part in "editing" belonged to metal ions, first of all, zinc, iron, copper and molybdenum.

Thus, the structure of any protein is, to some extent, relic – it has the memory of its accidental origin. In the course of evolution, new proteins were continuously created, as shown by the structural elements – α-spiral, β-tape, etc. – of their predecessors. It is hypothesis "designer" proposed by Chernavsky that is applicable here. Proteins and, moreover, genomes are constructed from already developed structural elements that form new combinations. The emergence of new valuable information is possible only if “the pool” of information with low value is available.

We usually speak about the increasing complexity of biological systems in the course of evolution. However, speaking of the complexity we mean the number of components making up the system. This definition appears, for example, in the classical work by von Neumann on the theory of self-reproducing automata. At the same time, von Neumann pointed out that with the high complexity of the object its description can be more difficult than the object itself. In complex systems of formal logic, it is much more difficult to say what the object can do than to produce it. Highly complex systems have, in principle, the ability to create something more complex than the systems themselves.

The most complex objects in nature are individual living organisms, among them – a human being. Each person is unique and cannot be encoded by a reduced program. In this sense – “no one is replaceable”. Obviously, the above also applies to the creations of man, for instance, to works of literature and art. It is impossible to give the minimum program of “War and Peace” – there is no algorithm to simplify the true work of art without losing its essence.

However, each organism is not just the individual. L. N. Tolstoy is not only a great writer – he is Homo sapiens. In other words, he is a representative of the animal kingdom, type of chordates, subtype of vertebrates, class of mammals, order of primates, superfamily of anthropoid primates, family of human beings (Hominidae), genus of Homo, species of Homo sapiens. Within each division all its representatives are equivalent, they are described by one and the same minimum program. Here – “no one is irreplaceable”, and as a representative of the species of Homo sapiens, any human being, regardless of skin color and other hereditary features, is equivalent to anyone else. As the modern theory of evolution demonstrates, the very emergence of this hierarchy, culminating with speciation, is determined by the natural selection and laws of genetics.

We see that the notion of complexity is relative – it depends on the level of consideration, level of reception. For a biologist the bull's brain is a complex system that requires hundreds and thousands of bits for its description, and for a butcher the same brain description requires no more than five bits, since the brain is just one of about thirty different parts of the bull's body used for food.

We see that the notion of complexity is similar to the notion of information value. We determined the information value, such as indispensability, non-redundancy at this level of consideration, level of reception.

First, the notion of complexity relates to the object, to the sequence of bits as a whole. On the contrary, we can speak about value – indispensability, non-redundancy – a single element of such sequence (Here, you can see that Volkenstein was unfamiliar with information units – metron and logon, he is aware only of the algorithmic approach of A. N. Kolmogorov to the complexity and measurement of information amount in bits. However, from the author's reflections we see that he is intuitively approaching metrons, their indispensability and he is unhappy about one-sidedness of measurements in bits).

Second, the notion of complexity characterizes only the object structure. On the contrary, the value, i.e. indispensability, is simultaneously reflecting the functionality of both the object and its individual elements.

Thus, the introduced notion of the information value is wider than the notion of complexity, and, actually, involves complexity. Using the notion of value, it is possible to overcome the difficulty associated with the fact that in the course of evolution process the simplification but not complication can take place. These facts contradict the increasing complexity in biological development. What happens in these situations with the information value?

Let us take the evolutionary simplification of the worm Bonellia viridis as an example. The female of this animal has a macroscopic size, it is a complex multi-cellular organism with diverse functions. The male, on the contrary, is microscopic, it lives in the female genital ducts and is only able for fertilization. It is obvious that the minimum program and complexity of the male are sharply reduced compared to the female. But what does it mean?

Presumably, the male genome is not too much different from the female one. However, the considerable number of the male’s genes is blocked, they do not function. The short program characterizes not the shortening of the genome, but the shortening of its functionality due to the indicated blocking.

The program reduction can occur for two reasons. First, the amount of functioning information can decrease, i.e. the acting unblocked genome can be shortened. Second, the text of this functional message can change, becoming more structured, i.e. the functioning information can be partially redundant. In this case, the text is simplified, it becomes less random. In the first case, the value of each element of the message, of each letter remains high and can even increase. In the second case, both the complexity and value decrease. There is a reason to think that at the evolutionary simplification determined by the specific adaptation of a parasite, or the male of Bonellia worm, the first case is realized – the complexity decreases and the specific value of the functional genetic information does not decrease and may even increase. The high value means high adaptation (and adaptability), indispensability of both the structure and functions.

We conclude that it is possible to introduce the principle of value increase but not the complexity increase as one of the basic principles of theoretical biology, i.e. the indispensability of information both in phylogenetic and ontogenetic biological development. This principle is not independent of natural selection and convariant replication (i.e. genotypic memory). However, it is the formulation of this principle that underlines the irreversibility, i.e. the directedness of biological evolution.

Further investigations, which should combine evolutionary biology with biophysics, require a detailed study of genomes. We do not yet know what part of the genome is responsible for specific features and which – for the individual ones. Based on the molecular-genetic data, the number of which is extremely small, relying on the information approaches already developed, the future science will build the model physical-mathematical theory of evolution. This theory will respond in the quantitative form to a number of questions related to materials and pace of evolution. We are at the beginning of the establishment of theoretical biology, the foundation of which was laid by Darwin and Mendel.

MATHEMATICAL INTERPRETATION

The perceiving subject is affected by the environment consisting of the set of objects with variable properties. The subject consumes substances from the environment with their properties, energy with various forms of its impact and forms "own" information about the environment acting upon it. The perceiving subject divides all properties of the environment into useful and useless in accordance with the ability to distinguish between a particular receptor, i.e. special sensitive formation.

Let us designate various private useful properties as

$$P_1, P_2, P_3, P_4, P_5, P_6, P_7, ..., P_i, ..., P_n$$

Let us designate each primary environment action as

$$x_0, x_1, x_2, x_3, ..., x_{\max i} \ u \ \ P_i = f(x_i).$$

Let us designate the signal perceived by the given receptor as

$$y_{0i}, y_{1i}, y_{2i}, ..., y_{\max i}$$

The environment signals and indexes of useful properties have their own dimensions (substance and energy).

It is necessary to make the quantitative scale of the value of the received information. I. I. Schmalhausen pointed out that not the amount but the quality or value of the information is significant for the evolution. In all cases, when the information is compared and selected, it is based on its quality evaluation.

But how can we determine the information value? According to Volkenstein, the following magnitude can be taken as the measure of value:

$$V = \log_2 (P / P_o),$$

where P_o and P – probabilities of achieving certain targets before and after the information reception.

Since here we use the term “target”, it is evident that this definition, in contrast to the definition of the amount of information, is not universal. Different receptor systems have different “targets”, and what is valuable for one system may not have any value for the other. Thus, the information value is related to its reception. The information reception is a non-equilibrium and irreversible process of receptor system transition from the unstable state to one of the possible stable states. The availability of “target” means the presence of instability and selection of the resultant state. At the same time, new information appears in the receptor – the received message is memorized. Depending on the stock of the existing information, the system is characterized by one or another level of reception.

Let us point out again the main idea that there is nothing beyond the processes of substance, energy and information conversion. Consequently, any system tends toward the same target – to keep the cycle of its single process of substance, energy and information conversion for its endless repetition.

Therefore, the receptors do not provide the probabilistic assessment of the value of environment signals, but perform it following the strictly deterministic logic: useful-useless (dangerous).

FROM THEORY OF DESIRABILITY FUNCTIONS

Let us assign the environment action scale y_i to the scale of desirability, utility d_i, varying from 0 to 1. If the action of the environment y_i onto the receptor is useless (dangerous), then $d_i = 0$, if y_i is useful, then $d_i = 1$.

It is necessary to find the function of transition of various scales of the environment action intensity on the receptors into the dimensionless scale of value coefficients. Finding this function is not obvious and, apparently, is very difficult. Here you can use the proposal on the application of the desirability scale, which refers to psycho-physical scales for match marking between physical and psychological parameters [Kartasheva T. M., Shtarkman B. P. Generalized criterion of optimization – desirability function. // "Information materials". Moscow: VINITI, 1970. № 8(45)].

The desirability value and the corresponding numerical labels can be selected according to the following scale:

Numerical labels by the scale	Desirability of property
0,80 – 1,00	very favorable
0,63 – 0,80	helpful
0,37 – 0,63	can agree
0,20 – 0,37	of little use
0 – 0,20	useless
– 0	dangerous (destructive)

When designing the desirability scale, the following two situations can occur.

1. There is a list of measured intensities (indexes) with one or two restrictive limits, in which the requirements to all properties interesting for a researcher are clearly formulated. The constraints can be defined as

$$y \le y_{\max}\,,\ \ y \ge y_{\min}\ \text{ or }\ y_{\min} \le y \ge y_{\max},$$

in case of two restrictive limits. Here: y – current value of the property, and $y_{\max}$ and $y_{\min}$ – maximum and minimum allowable values of the property.

2. There is no list of measured intensities (indexes) of action. There can be two options. In the first case, the marks are put on the desirability scale d = 0,37 in accordance with the value of the properties y_{max} and y_{min}, the remaining intermediate marks are determined by the importance of this property and possibility of improving it. In the second case, each amount of the property can be evaluated in terms of its value only purely subjectively, so in quantitative determination of utility (desirability) it is useful to take into account the opinions of several researchers (analyzers).

The desirability scale design and the set of the transition relation between property values and their desirability are the most difficult and important step in the procedure of calculating the generalized quality index *D*.

The transformation, establishing the relationship between the values of property y and its desirability d, can be defined as a private function of desirability, in contrast to the generalized desirability function that establishes the correspondence between the values of some properties and generalized index of desirability *D*.

The simplest case of converting the property value into the desirability scale occurs when there is the specification with one or two restrictive limits and these limits are the only criteria of usefulness. Then, the value d = 0 is set beyond the specification, and d = 1 – inside it. Let y be the perceived (measured) property, and y_{min} – lower limit of the specification setting the unilateral limit. Then the private desirability function takes the following form:

$$d = \begin{cases} 0, y < y_{min} \\ 1, y \geq y_{min} \end{cases}$$

Similarly, we obtain the private desirability function, if the specification sets the limit from the top. If there is the bilateral limit for this property, then

$$d = \begin{cases} 0, & y < y_{min}, y > y_{max} \\ 1, & y_{min} < y \le y_{max} \end{cases}$$

However, the specification restrictive limits are not always the sole criteria of usefulness. In most cases, the measured properties cannot be expressed by the desirability scale with the help of linear conversion of scales and it is necessary to look for the methods based on the use of more complex conversion laws.

If the limitations for the given property are specified in the form $y \le y_{max}$ or $y \ge y_{min}$, then the desirability function is as follows:

$$d = exp\ [-exp(-y')],$$

where $y' = b_0 + b_1 y$. Coefficients b_0 and b_1 can be calculated, if we set the corresponding desirability values d, preferably in the range of $0{,}2 < d < 0{,}8$, for two values of y. With the lack of specifications, there is some uncertainty in setting the control points, and it is necessary to search for statistical values of b_0 and b_1 by the series of selected values of d and y.

The non-linear transformation of y into d is used when this index is of particular importance and the sharp change in desirability near the restrictive limit corresponds to the small change in the property.

For the property limited by $y_{min} \le y \le y_{max}$, it is convenient to set the transformation of y into d by the following expression:

$$d = exp[-(\,|\,y'\,|)^n \,,$$

where n – positive number ($0 < n < \infty$), and

$$y' = \frac{2y - (y_{\max} + y_{\min})}{y_{\max} - y_{\min}}$$

The degree index n can be calculated, if we set value d to some property y (probably in the range $0{,}6 < d < 0{,}9$) following the formula

$$n = \frac{\ln \ln \frac{1}{d}}{\ln |y'|}$$

After the conversion of scales we can form the generalized utility index D and express it through the geometric average of desirabilities of individual properties, i.e.

$$D = \sqrt[N]{d_1 \cdot d_2 \cdot d_3 \cdot d_4 \cdot d_5 \cdot d_6 \cdot d_7 \cdot d_8 \cdot \ldots \cdot d_N} \,.$$

The generalized desirability function presented in this form is a convenient model of psychological reaction of the perceiving subject (the experimenter, researcher). If at least one of the properties does not entirely satisfy the set requirements, then no matter how useful (good) are the rest of the properties, this object does not correspond to the expediency of the evolutionary process of the given species.

For example, the private index of quality (utility) U_1 has the desirability $d_1 = 0$, then the generalized function of desirability $D = 0$ and subject (researcher) cannot use the perceived object in its evolutionary process. $D = 1$ only when all $d_i = 1$.

With the generalized index of properties D we can do all calculations and it can be used as an optimization criterion when investigating processes with any of the known methods. The generalized desirability function is homomorphic to the real properties and is the relation of normalizing in the variety of their values.

The creation of transition methods from the measured consumption (useful) properties to the desirability values, the set of quality indexes to determine the generalized desirability function represent an individual scientific problem as applicable to different classes, groups, species of evolutionary (transforming substance and energy) processes.

In conclusion, let us return to our simple, given to Man by God, and to quantify the value of its generalized desirability function. For example, a human being perceives the external object and scans its properties with sense organs: 1) color – white, 2) smell – pleasant, 3) feeling – warm, 4) gravity – solid, light, 5) taste – sweet, 6) sound – quiet, 7) place in space – near. Conclusion: you can eat it. The reflection process was recorded as a positive result, and by comparing with other phenomena it is marked with time and encoded in memory (please, forgive me for vulgarization) as the word "sugar".

In the above case, each private desirability function had the following on the scale of the corresponding receptor: color (d_1 = 1), smell (d_2 = 1), feeling of warmth (d_3 = 1), gravity (d_4 = 1), taste (d_5 = 1) sound (d_6 = 1), space (d_7 = 1). In accordance with the receptor data, the system recorded the generalized desirability function:

$$D_{t_0} = \sqrt[7]{d_1 \cdot d_2 \cdot d_3 \cdot d_4 \cdot d_5 \cdot d_6 \cdot d_7} = \sqrt[7]{1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1} = 1.$$

and left in the memory the recorded signal matrix, generally designated with the word "sugar", for the period t_0.

Each cycle of the perception process is recorded sequentially in the memory, and this sequence creates the time scale.

Another case that occurs after the first one: 1) color – white, 2) smell – pleasant, 3) feeling – warm, 4) gravity – light, solid, 5) taste – bitter, 6) sound – quiet, 7) place in space – near.

All private desirability functions by scale receptors are marked with: color – $d_1 = 1$, smell – $d_2 = 1$, feeling – $d_3 = 1$, gravitation – $d_4 = 1$, taste – $d_5 = 0$ (not sweet), sound – $d_6 = 1$, space – $d_7 = 1$. The perceiving system determined the generalized desirability function:

$$D_{t_1} = \sqrt[7]{1 \cdot 1 \cdot 1 \cdot 1 \cdot 0 \cdot 1 \cdot 1} = 0$$

and left in the memory the recorded signal matrix, generally designated with the word “not sugar” but “salt”, for the period t_1.

Perhaps, these examples too trivially explain the complex psycho-physiological processes of perception, but they give the reason to reflect on the possibilities of designing quantitative measures and scales to represent the evolutionary processes of substance and energy conversion in the informational aspect by applying the notion “quantum information” and designing the scale of complexity measures.

9
What is life?

"Despite all the deep rationales, refined concepts and subtle studies, we, therefore, have not yet reached the understanding of the matter and continue to ask: what is life?" [Engels F. Anti-Dühring. Moscow: State publishing house of political literature, 1951. P. 322]. It seems that there is no point in looking at this question so as to search for some profound answers, since ordinary human existence always explains it with its clarity. But this is only the appearance of the phenomena of life. All social science and practice are inherently engaged in nothing more than the desire for knowledge and understanding of life itself and the purpose of life. There are no trivial answers yet.

Politics and economics as a form of activity of a certain group of people claiming the role of managers and ensuring the life activity of society do not so often seek convincing answers to vital everyday questions.

Meeting with a familiar person, we ask: "How do you live?" And then we mean the state of health, that is, mentally we let the whole variety of physiological and psychological processes of life through the system of perception.

GENERAL THEORY OF LIFE

If we turn to philosophical reflections, we often recall the well-known assertion in many philosophical reference books: "Life is a way of existence of protein bodies, and this way of existence is, in essence, in the constant self-renewal of the chemical constituent parts of these bodies" [Engels F. Anti-

Dühring. M.: State publishing house of political literature, 1951. P. 77-78].

The academician in biology and cybernetics says: "What is life? The most common answer is the change of systems in time and space according to their programs. In this sense, the living differs from the inanimate only in the program complexity. You can determine the most important programs of living systems: growth, reproduction, movement. More common is the metabolism with the environment" [Amosov N.M. Some questions of modeling complex systems // Cybernetics for the service of communism. Moscow-Leningrad: Energia, 1967. V. 4. P. 266].

The naturalist asserts in his philosophical ideas: "Life is a planetary natural geological phenomenon that builds the biosphere and the noosphere and is manifested in masses of matter, perhaps insignificant in comparison with the mass of the biosphere, but quantitatively determined in the mass of the biosphere substance and in its energy effect playing a leading role in the biosphere. Taking life in this aspect, the biogeochemist, dealing primarily with the biological manifestations of life, with the aggregates of living organisms, immediately encountered a sharp, impassable physical and chemical difference in living matter from the inert substance. There is no "life" outside the living organism in the biosphere. On a planetary scale, life is the totality of living organisms in the biosphere, with all their changes in the course of geological time" [Vernadsky V. I. Philosophical thoughts of naturalist. Moscow: Nauka, 1988. P. 194].

And here is what the biophysicist writes: "Let us define a living organism as an open, self-regulating, self-reproducing and developing heterogeneous system, the most important functional substances of which are biopolymers - proteins and nucleic acids. The organism is a historical system, in the sense that it is the result of phylogenetic, evolutionary development and passes itself the path of ontogenetic development – from zygote to old age and death". [Volkenstein, M. V. Biophysics. Moscow: Nauka, 1988. P. 13].

In the last decades of the development of scientific thinking, on the one hand, there is a differentiation of different sciences, one way or another related to the study of life processes and the ever more profound penetration into biological micro-life. Modern biology, as is well known, is very diverse, multidirectional both in the application of methods of other sciences: mathematics, physics, chemistry, cybernetics, etc., and the methods of various theoretical disciplines related to them: molecular biology, biophysics, biochemistry, biocybernetics, mathematical biology, etc.

On the other hand, there is a steady process of integration of various scientific directions in the search for the fundamental laws of life and evolution. The specificity of the current stage of the knowledge synthesis provides a real opportunity for the transformation of the science of living from the so far unrelated facts and theories into a single integrated knowledge where all the principles and facts are internally and organically interrelated. This integrative aspiration manifests itself more and more in the form of the creation of general theory of life. [Yugai G. A. The general theory of life. Dialectics of formation. Moscow: Mysl, 1985. 256 pp.].

In accordance with the methods of research, there are four main directions in the formation of the general theory of life (GTL). The first direction is conditioned by the application of methods and theories of non-biological sciences, among which a special role is played by the complex of physical and chemical sciences that give grounds to understand GTL as a physicochemical theory of the essence and general laws of life development. The second direction is the orientation toward abstract, formal-logical theoretical schemes based on mathematics. The third direction is the application of a systematic approach based primarily on methods of biocybernetics and organization principles of biological systems. The fourth direction is targeted at general biological principles of the noosphere evolution, i.e., to the knowledge of biogeochemical foundations of the life evolution on Earth and natural scientific foundations of social development.

Knowledge of the life essence involves the use of non-biological theories and methods that must be subordinated to proper biological theories and methods.

The fundamental objective basis of the unity of the biological approach to life is seen in the process general for all matter, which is the exchange of matter, energy and information. The expediency of life as integrity coincides with its function associated with the transformation of cosmic energy into the terrestrial one. From this function all other functions of life as integrity are derived [Yugai G. A. The general theory of life. Dialectics of formation. Moscow: Mysl, 1985. P. 192].

MATERIAL-ENERGY AND INFORMATION UNITY OF LIFE

The author's adherence to a certain scientific area is visible in the definitions, but each of them reflects the basic concepts: **system, process, substance, energy, information**.

Of course, every form of life is a phenomenon of the process, that is, a regular, consistent change in the phenomenon, its transition to another phenomenon. On the other hand, every process is a manifestation of development, as a self-movement from the lower (simple) to the higher (complex), revealing, realizing the internal tendencies and essence of phenomena, leading to the emergence of the new. Every separate development process has the beginning and the end, and the completion of this cycle of development gives rise to a new process, in which certain features of the former are repeated. Development is an immanent process: the transition from the lower to the higher arises because tendencies leading to the higher are present in the lower in a hidden form, and the higher is the developed lower. In this case, only at the sufficiently high stage of development, allusions to the higher, contained in the lower, are fully revealed and are, for the first time, understandable. For example, consciousness is the result of the entire objective world development, which passes into the noosphere, and only from this point of view can one disclose the property of reflection lying in the foundation of matter.

Life exists in the form of separate living organisms, each of which originates from its kind, goes through a cycle of individual development, produces similar ones and dies. Organisms, in connection with the inanimate environment and with each other, thereby form a system of more complex orders and finally – the unified system of life on Earth, having passed the development from the simplest forms to humans.

The above reflections allow us to formulate the following definition: **life is the way of existence and evolution of the system of protein bodies, manifested in the form of processes of transformation of matter and energy and accumulation of information**.

MATHEMATICAL SUMMARY

Guided by the principles of synergism and taking into account that "the synergistic connection in cybernetics and general theory of systems is defined as a bond that, under cooperative (joint) actions of independent elements of the system, provides an increase in their overall effect to the magnitude greater than the sum of the effects of the same elements acting independently", we will write down:

$$F(X_S, X_E, X_I) > [F(X_S) + F(X_E) + F(X_I)],$$

where X_S – substantial factors entering the process;

X_E – energy factors entering the process;

X_I – information manifestation of the process;

$F(X_S)$, $F(X_E)$, $F(X_I)$ – functions (result) of substance, energy and information interaction in the process.

Consequently, the functional dependence presented here is just another expression of synergism in the evolutionary tendency. Whatever is the result of local processes towards negative synergism, the overall development flows in the positive direction, and this is the "invincibility" of synergism.

It should be noted only that Marx profoundly analyzed "newly discovered" synergism in "Capital" as a new force, "which arises from the fusion of many forces into one general ...". The same phenomenon was studied in detail by A. A. Bogdanov in his work "Tectology. (General Organizational Science)". [Bogdanov A. A. Tectology. (General Organizational Science). Moscow: Economics. 1989. In the 2nd book; Book 1 - 304 p.; Book 2 - 351 p.].

“Man” is a **whole** world of experience ... The task is to give the **scientific** and, at the same time, **integral**, and not only partial, concept of “man”. To do this, we need to consider a person not only as the whole world of experience, but also as the unfolding world, not limited by any unconditional limits”. [Bogdanov A. A. Questions of socialism. Works of different years. Moscow: Politizdat. 1990. 479 p. P. 29-30].

10

Man – a biosocial system

BIOLOGICAL CHARACTERISTICS OF HUMAN – SUBJECT OF LABOR

In connection with the fundamental importance of biological achievements in the problems of labor qualimetry we are considering, it is necessary to bring here a broad interpretation of the term **biology** (Greek bios – life + Greek logos – word, teaching) – a complex of knowledge about life and set of scientific disciplines that study **the living**. The emergence of biology is associated with the names of ancient doctors and philosophers (Hippocrates, Aristotle, Theophrastus, Galen and others). Their works laid the foundation for botany, zoology, anatomy and human physiology. In the 17–18th centuries methods of quantitative measurements and experiments became its property. With the invention of the microscope, biology entered the mystery of the microworld. In 1735 K. Linnaeus laid the foundations of modern systematics of plants and animals. In 1839 the German biologist T. Schwann created a cellular theory, and the Austrian (Czech) naturalist G. I. Mendel (1822-1884) discovered the main regularities of heredity. The doctrine by Charles Darwin (1809-1882) on the laws of evolution produced the revolution in biology. In the 20th century the idea about qualitatively different **levels of organization of life** (molecular, cellular, organism, population-species, ecosystem, biospheric) was formed and studies of structures and properties of the living deepened, especially fine structures (molecular biology, structure of genetic apparatus) and the global theory of

V. I. Vernadsky about the biosphere and noosphere. The important milestones in the history of biology were the development of genetic soil science by V. V. Dokuchaev (1846-1903), study of landscapes and hypothesis of nomogenesis by L. S. Berg (1922). In connection with the phenomenon of environmental crisis, biology advanced to the forefront of natural science by the end of the 20th century, having undergone significant changes and partly merged with related sciences. Ecology has emerged from biology, geography and social sciences, and has become an independent scientific discipline on the vital activity of human society in unity with the natural environment.

Biology considers general and particular regularities inherent in life in all its manifestations and properties: metabolism through consumption and excretion, reproduction, heredity, variability, adaptability, growth, development, irritability, mobility, death. The complex of biological knowledge is attached to various **levels of life organization**. Classification of biological disciplines is possible by dividing them into branches:

- systematic-classification (in systematic categories);
- spatial-organizational (by the levels of organization of the living – from molecular to bio-mediated);
- evolutionary-dynamic (individual and evolutionary development);
- behavioral-informational (a group of disciplines that study the behavior of organisms and transmission of information in the living world);
- functional (about physical, chemical, physiological, ecological and other phenomena in the living world);
- ergonomic ("boundary-hybrid", including elements of natural science, engineering, design and social aspects of workplace in labor processes);

- applied in biogeophysical areas (biometeorology, bioclimatology, magnetobiology, bioengineering, biomechanics, bio-purification, biotechnology, etc.).

MAN – A BIOSOCIAL SYSTEM

From the stated biological provisions it follows that the "system of protein bodies" is a biological system, i.e., a **life-manifesting** system. In turn, life-manifestation is the existence and evolution of protein bodies. The term "evolution" (Latin evolutio – development) was introduced by the Swiss scientist S. Bonnet in 1762 and means the irreversible and directed historical development of living nature. Evolution is accompanied by a change in the genetic composition of populations, formation of adaptations, formation and extinction of species, transformation of ecosystems and biosphere, as a whole. Evolution is characterized by variability, heredity, natural selection of organisms. In the course of evolution, organisms and ecosystems adapt to the constantly changing environmental conditions – abiotic and biotic.

Due to the fact that our research is based on the systematic understanding of life of the population of protein bodies, it is necessary to state the author's understanding and definition of the category **"system"**. The formulation of the system definition is based on the Greek word systēma, literally – the whole, composed of parts. In various reference-books and dictionaries, many definitions of the concept of "system" are given. However, we repeat that for our research the most acceptable is the following one: **system is a set of elements interconnected in such a way that the impact of the environment (another set) on some part of the elements leads to a change in the state of the whole set**.

In biological interpretation, the above definition means a set of regularly interconnected functional elements (protein bodies) representing the integral formation, unity, for example, the human body as a systematized unity of the set of cells.

The Great Soviet Encyclopedia and Philosophical Encyclopedic Dictionary propose the following definition. “**Man**, the highest level of living organisms on Earth, the subject of socio-historical activity and culture. Man – the subject of study of various fields of knowledge: sociology, psychology, physiology, pedagogy, medicine, etc. By processing the diverse data of these sciences, philosophy gives them a certain interpretation and understanding. The issue of the nature (essence) of man, his origin and purpose, position of man in the world is one of the main problems in the history of philosophical thought”. It is also indicated that the general picture of genesis and evolution of man looks rather complicated and cannot be considered as cleared up completely. However, the more intensively the humanity develops, the more complicated are the problems of education and upbringing, formation of a human as the personality.

Here, under the personality we understand: “1) a human individual as a subject of relations and conscious activity (a person in broad sense) or 2) a stable system of socially significant features characterizing an individual as a member of one or another society or community” Philosophical encyclopedic dictionary. Moscow: Sov. Encyclopedia, 1983. P. 314]. A personality is defined by this system as of social relations, culture and is also conditioned by biological features. The notion “personality” needs to be distinguished from such notions as “individual” (a single representative of humanity) and “individuality” (aggregation of features differentiating this individual from all the others) [Great encyclopedic dictionary /

Ed. by A. M. Prokhorov. 2nd edition, revised, add. Moscow: Great Russian Encyclopedia, 1998. 1456 p.].

Studying a person as a biosocial system, we do not go into detail about the ongoing chemical and physical processes in the person, though they are the basis of all human activity and largely determine its features. In this case, the consumption processes (incoming flows) are the research object and consumption results (outgoing flows) – a product of life activity. Here a person can be represented as a black box. Therefore, it will be fair to note that the person and his life are studied by us from the standpoint of special science – cybernetics – and its principles: systematicity principle, black box principle, monitoring of incoming and outgoing flows, feedback availability.

The behavior of a person is directly determined by thinking, feelings, will, degree of knowledge of the laws of nature, society, himself. In fact, the human essence is not "an abstraction inherent in an individual, but the totality of all social relations" [Marx K., Engels F. V. 42. P. 265]. Therefore, the society cannot be considered as something external to a person, a kind of "environment". The whole content of social life is created or recreated (inherited) by various forms of human activity. Similarly, there is nothing in the human himself, except for signs of his social nature: "**The human essence** is always the **true community of people**" [Marx K., Engels F. V. 1. P. 447], "... the social history of people is always only history of their individual development ..." [Marx K., Engels F. V. 27. P. 402-403]. "History is **nothing but** the activity of a person pursuing his goals". [Marx K., Engels F. V. 2. P. 102]. Therefore, the problem of studying the quality of human life can be solved in unity with the task of creating a truly human society in the process of cultural and creative activity of people themselves.

In the modern world, a human is a biosocial being, but, in spite of this, has a predominantly biological basis for existence, and social aspects are an additional basis at a certain level of his evolution. Biologically, a human needs food, clothing, shelter, etc. We have every right to consider a human as a specially organized biological system using various objects (matter and energy) from the environment to counteract entropy and “extract” information.

The value of objects of the world around is, on the one hand, their positive or negative significance for the human, determined not by their properties themselves, but by their involvement in the sphere of human life, interests and needs, social relations; the criterion and ways of assessing this significance expressed in moral principles and norms, ideals, prescriptions, goals. On the other hand, the value is the ratio of the thing utility to the production cost. Thus, life values can be represented from the point of the correspondence of the real parameters determining these vital processes as optimal or ideal.

Here there is a direct connection with the metabolism, which is a set of physical, chemical and physiological processes of the transformation of substances and energy in the human body and the exchange of substances and energy between the body and environment, ensuring its life. And in these processes there is a direct mutual definition of the concepts “man” and “labor”.

Analyzing the definitions of labor and labor force given in classical political economy, it is not difficult to see that the labor force used for the realization of labor processes is identified with the resources of substance, energy and information accumulated by man in the process of vital activity, and the process of using labor force or labor, is directly connected with the expenditure of these resources, which requires their timely replenishment in order to ensure the continuity of the chain of transformations and its repetition. That is, through the interaction with the environment, the available energy-information resources should be maintained in the amount sufficient to ensure the exchange processes at a level higher than the basic one. In order to spend, you must first save (i.e., obtain). Initially, the society contributes to this accumulation, and then a human in the process of labor and social life makes up for the costs incurred by the society.

Man accumulates substance, energy and information received from the external environment and uses (consumes) them to maintain its vital activity, as well as to carry out work aimed at changing the conditions of the external environment (habitat), though different people perceive the same conditions of life differently. The reasons for these differences are ultimately determined by different understanding of the sense and purposes of life.

The considered characteristics of man as a biosocial being lead to another very important category: **personality**. This category is, in a sense, a "bridge" for the transition from the biological being of man to the social manifestation of human functioning in the external environment of his biological relatives. Therefore, personality is a human with his socially conditioned and individually expressed **qualities: intellectual, emotional, volitional.** The scientific understanding of the personality rests on certain human essences as the totality of social relations. In psychology, a personality is every individual with his own individual characteristics of character, intellect, emotional sphere.

Changes in the psychological make-up of a personality are the consequence of those changes that occur in the being of man as a biological system in changing natural and social conditions, i.e., a personality is a coherent set of internal traits and characteristics of a human through which all external effects are interpreted.

The activity sources of a personality are its diverse personal and social **needs**; subjective in the personality (experiences, consciousness, needs) is inseparable from the objective relations between a person and the surrounding reality. The level of personality development depends on how historically progressive these relations are. The relationship between the individual and society is different in different historical epochs because there is no “society in general”, but there are actually certain socio-economic formations with their stages of development, and there is no “personality in general”, for a personality person is always the product of a historically given social system.

Such concepts as nutrition, excretion, renewal are covered by the definition of life given by F. Engels. Let us consider each of them separately and then unite them in relation to the aggregated concept – biological system.

To consume (what, where, what for) is to spend, to keep, to spend, to exhaust, to use, to expend for some need, on demand (to eat, to devour, to destroy, to demolish). Bear consumed the cow, ripped, ate. To use clothes, to wear out them all, at all, to decay. [Dal V. I. Explanatory dictionary of the live Great Russian language. St. Petersburg: Diamant. 1998].

Excretion (Latin excretum – “excretion”) is the liberation of organism from final products of metabolism, foreign substances and excess of water, salts and organic substances coming from food or formed in the human body and animals [Soviet encyclopedic dictionary. Moscow: Soviet Encyclopedia. 1981].

Renewal, to renew, to resume, to restore, to reconstruct; to revive, to refresh, to enliven spiritually, to renew oneself [Dal V. I. Explanatory dictionary of the live Great Russian language. St. Petersburg: Diamant. 1998].

Nutrition makes significant difference between the organic and inorganic kingdom. Nutrition consists in food ingestion and digestion; this is the conversion of external matter into one's flesh. Nutritious, nourishing, filling or saturating; suitable for absorption and digestion [Dal V. I. Explanatory dictionary of the live Great Russian language. St. Petersburg: Diamant. 1998].

So, in such way V. I. Dal considered the main attributes of life manifestation – nutrition, excretion, renewal, consumption in Russian understanding.

The modern science of nutrition completely confirms the essence of the life concept formulated by F. Engels. To affirm this view, it is sufficient to cite the concept of nutrition given in "Brief medical encyclopedia" [Brief medical encyclopedia. Moscow: Soviet Encyclopedia. 1989. P. 414-415]. "Nutrition is the process of intake, digestion, absorption and assimilation by the body of nutrients necessary to compensate for energy costs, construction and renewal of cells and tissues of the body, exercise and regulation of body functions. In the process of nutrition, food substances (food chemical substances assimilated during metabolism in the body) enter the digestive organs, undergo changes under the action of digestive juice enzymes, are absorbed in the intestine and get into the circulating fluids, thus becoming constituent parts of the internal environment of the body".

It is natural to believe that the above reasoning is obvious for every person who is fully satisfied, enjoying himself (ancient Greek – hedon – hedonist) from the very process of eating. However, the political economic arguments about life, the formulation of the notion “life” are far from the natural scientific **basis** of the organism vital activity. Therefore, there is a need to address the natural scientific fundamental categories, such as the concept of life, because our research is related to the development of methods for quantifying the quality of life (qualimetry of life) in its primary and social meaning as a human-subject of labor.

For example, you can refer to “Modern economic encyclopedia” [Vechkanov G. S., Vechkanov G. R. Modern economic encyclopedia. St. Petersburg: Lan, 2002]. The notion “life” in it is applied to the description of another notion – “goods” through the “product life cycle” – “the period of time from the beginning of a certain **product** development till its withdrawal from the **sphere of consumption**, i.e., the product viability on the market”.

However, the authors of the economic encyclopedia should know the etymology of the word “life” given by V. I. Dal: “**Life**, existence, genesis; state of an individual, existence of an individual. In a vast sense, **life** is conditioned only by the nutrition and digestion of food, and, in this sense, it is given to two kingdoms of nature: animal and vegetable; in the narrow sense, it requires arbitrary movement and feelings, belonging only to animals; in the highest sense, as **genesis**, it refers to the soul or death of flesh” [Dal V. I. Dictionary of the live Great Russian language. St. Petersburg: Diamant. 1998. V. 1. P. 541].

Apparently, the etymology by V. I. Dal demonstrates once again the profound meaning of the definition of life given by F. Engels, adequately reflecting the actual content of specific processes of life activity.

METABOLISM AND ENERGY EXCHANGE IN LIFE PROCESSES

There is another concept that holistically combines all the attributes described by us and expounds them in interconnection and action as a systemic formation – the concept of **metabolism and energy exchange**.

Metabolism and energy exchange – a set of processes of the transformation of substances and energy occurring in living organisms, and exchange of substances and energy between the organism and environment. It is the basis of vital activity and belongs to the number of the most important specific signs of living matter that distinguishes the living from the lifeless. Here again we find the reflection of F. Engels' correctness on the philosophical definition of life. In the process of exchanging the substances getting into the body, they are transformed through chemical changes into the own substances of the tissues and final products that are excreted from the body.

From the point of view of thermodynamics, living organisms are open systems as they exchange energy and substance with the environment. However, living substances are not in equilibrium with the environment and, therefore, are non-equilibrium open systems. Nevertheless, no visible changes occur when observed during a certain period of time in the chemical composition of the body. The apparent constancy of the chemical composition of a living organism is explained by the fact that the rate of substance and energy transfer from the environment into the system is exactly balanced by the transfer rate from the system into the environment.

The indicated feature of living organisms in the general theory of systems and cybernetics is called "homeostasis"

(Greek homoios – similar, identical + Greek stasis – immobility, state). In economic-mathematical modeling, homeostasis is a stable state of the system equilibrium in its interaction with the environment. This concept came to economics from biology, where it is used to characterize physiological processes, for example, such as maintaining a constant body temperature regardless of the ambient temperature.

All living organisms of the biosphere are interconnected, in one way or another, in terms of nutrition. This phenomenon is called “synthrophy” – “joint nutrition”. Phototrophs, being photosynthesizing organisms, form organic substances (for example, glucose), which are contained in the carbon dioxide atmosphere, and release oxygen into the atmosphere; heterotrophs use glucose and oxygen in the course of their inherent metabolism and return carbon dioxide to the atmosphere as the final product of metabolism.

This carbon cycle in nature is closely connected with the planetary energy cycle. Solar energy is converted during photosynthesis into the chemical energy of the recovered organic molecules, which are used by heterotrophs to cover their energy needs.

The chemical energy received by heterotrophs, especially higher organisms, from the environment, often turns directly into heat (maintaining a constant body temperature), and partly into other forms of energy associated with the performance of various kinds of work: mechanical (muscle contraction), electrical (nerve impulse conduction), chemical (biosynthetic processes taking place with energy absorption), work related to the transfer of substances (glands, intestines, kidneys and others).

Nitrogen necessary for the synthesis of proteins and nucleic acids is no less important for living organisms.

Atmosphere is the main reserve of nitrogen on Earth, consisting of almost 4/5 of molecular nitrogen.

The laws of conservation of substance and energy served as a theoretical basis for developing the most important method for studying metabolism and energy exchange – establishing balances, i.e., determining the amount of substance and energy entering the body and leaving it in the form of heat and final products of metabolism. To determine the balance of substances, it was necessary to create precise chemical methods for their determination and knowledge of the ways to excrete various substances from the body. It is known that proteins, lipids (fats) and carbohydrates are the main food substances. To assess the protein content in food and decay products, it is sufficient to determine the amount of nitrogen, since practically all of the food nitrogen is in proteins. The nitrogen content in proteins is approximately constant and, at an average, is 16 g per 100 g of protein and 1 g of excreted nitrogen corresponds to 625 g of protein involved in metabolism. The determination of fats and carbohydrates in food products is done by specific methods, and carbon dioxide and water are almost exclusively the final products of the exchange of fats and carbohydrates.

When analyzing the final products of metabolism, it is necessary to take into account the ways of excreting them from the body. Nitrogen is excreted mainly in urine, but also with feces and, in small amounts, through the skin, hair and nails. Carbon is released almost exclusively in the form of carbon dioxide through the lungs, but some amount of it is excreted in urine and feces. Hydrogen in the form of water is excreted mainly with urine and through the lungs (water vapor), but also through the skin and with feces.

One of the significant excretions is sperm, the product of the vital activity of animals (humans) aimed at one of the main target functions – reproduction.

The energy balance is determined based on the caloric content of the nutrients to be administered and the amount of heat released, which can be measured or calculated. It should be borne in mind that the absolute value of caloric content may differ from the physiological (energy) caloric content of nutrients, since some substances in the body do not completely burn out, but form final products of metabolism, which are still capable of further oxidation. First of all, this refers to proteins, whose nitrogen is excreted from the body mainly in the form of urea retaining a certain potential supply of calories.

The detailed description of the process of metabolism and energy exchange in the biological system reflects the scientific depth and practical validity of F. Engels' definitions about life. Moreover, from his definition through procedural system development of the definition itself is quite acceptable for proving the scientific adequacy of the definition of life and metrological magnitudes, their dimensions and scale of measuring physiological processes, quantitative representation of the results of physiological manifestations of life in metric units. Thus, from the general philosophical generalizations of different points of view to the essence of life and brief but science-intensive definition, further – the transition to the broad development of empirical researches leading to quantitative ratios of magnitudes, and ultimately to measuring metrological procedures – this is the way to develop the concept of life. **This is the great philosophical merit of F. Engels. And this is the task of qualimetry.**

The important value characterizing the peculiarities of the exchange of individual substances is the respiratory coefficient (RC), which numerically equals the ratio of the exhaled carbon dioxide to the volume of absorbed oxygen. Caloric value, RC and heat generation value calculated for

1 liter of consumed oxygen are different for different substances. The average values of these magnitudes for the most important nutrients are summarized as a result of biological experiments (Table 10.1).

Table 10.1

Average values of caloric content obtained by burning physiological caloric value

Foodstuffs	Caloric content during burning (kcal/g)	Physiolo-gical caloric value (kcal/g)	Consump-tion of oxygen (l/g)	Excretion of carbon dioxi-de (l/g)	Respira-tory coefficient	Value of heat genera-tion calcula-ted for 1 liter of con-sumed oxygen (kcal)
Carbohyd-rates	4,1	4,1	0,829	0,829	1	5,05
Lipids (fats)	9,4	9,3	2,019	1,427	0,7	4,69
Proteins	5,6	4,1	0,966	0,774	0,8	4,49

The data given in Table 10.1 are widely used for quantitative calculations conducted to characterize energy exchange in animals and humans. Knowing the amount of absorbed oxygen, carbon dioxide released and urinary nitrogen excreted, it is possible to calculate the heat production and amount of protein, carbohydrates and lipids converted into final products over a certain period of time.

The exchange intensity is estimated by the total energy expenditure, it can vary depending on many conditions and, first of all, on physical work. However, even in a state of complete rest, metabolism and energy exchange does not stop, and the potential energy of food is consumed to ensure the continuous functioning of internal organs, maintaining the tonus of muscles and other organs.

To assess the individual characteristics of metabolism, it is customary to determine the intensity of metabolism in the so-called standard conditions (with complete physical and mental rest) in the lying position, 14 hours after the last meal, at ambient temperature providing the feeling of comfort. The received value is usually called **the basal metabolism**. Thus, with young men the basal metabolism is 1300-1600 kcal/day or 40 kcal · m^2/hour. With age (starting from the age of 5 years), the amount of basal metabolism decreases (from 52,7 kcal · m^2/hour with 6-year-old boys to 34,2 kcal · m^2/hour for men in the age of 75-79). With women, the basal metabolism is 6-10% lower than with men. With an increase in body temperature by 1°, the amount of basal metabolism increases by approximately 13%. The increase in the intensity of metabolism is also observed with a decrease in the ambient temperature below the comfort zone.

Physical work is the determining factor in the amount of metabolism and energy. The metabolism with intensive physical activity targeted at energy consumption can be 10 times higher than the basal metabolism, and in very short periods of time (for example, when swimming at short distances), even 100 times higher.

Nutrition is the process of ingestion, digestion, absorption and intake of nutrients necessary to compensate for energy expenditure, construction and renewal of cells and tissues of the body, exercise and regulation of body functions. In the process of nutrition, food substances (food chemicals assimilated in the body during metabolism) enter the digestive organs, undergo changes under the action of digestive juice enzymes, are absorbed in the intestine and get into circulating fluids, thus becoming constituent parts of the body internal environment. Proper rational nutrition contributes to the fact that a person is less exposed to various diseases and copes with them more easily. Nutritional therapy is an essential component of complex therapy of gastrointestinal, cardiovascular and other diseases. To prevent the harmful effects of occupational factors, rations of therapeutic and preventive nutrition are specially developed.

The issues of human nutrition are closely related to social, economic and hygienic problems. Social factors are at the forefront in providing the population with food, though the geographical climatic conditions play a significant role in the production of food products. Specialized agencies of the United Nations, within the framework of national development of countries, proposed the long-term program to combat malnutrition and, first of all, protein deficiency. This program includes measures to reduce protein losses during processing of food products, to use proteins of low-consumable plants (e.g., protein from alfalfa leaves) in nutrition, to introduce highly productive plant varieties in agriculture, to use proteins obtained from fodder yeast or unicellular organisms to feed agricultural animals, to develop cultivation methods of such organisms, etc.

A serious social problem related to the struggle against obesity, atherosclerosis, diabetes mellitus developing due to overeating, sedentary lifestyle, eating refined foodstuffs, etc. arose in developed countries. Controlling the quality of foodstuffs and preventing food contamination, and introducing chemical additives into them, which have a harmful effect on human health, are carried out by the sanitary and epidemiological service in the Russian Federation. Among the social and hygienic measures for organizing the nutrition of population, a great role is played by the promotion of rational nutrition foundations, struggle against incorrect views, harmful habits and prejudices about nutrition.

The development of scientifically-based nutrition standards is the basis of its rational organization, including the organization of public catering, as well as the basis for the creation of products of children and dietary nutrition, prevention of nutritional diseases, etc. The theoretical basis of modern nutrition science is the concept of balanced nutrition with new ideas about the metabolism and energy exchange as its foundation.

Physiological needs of the organism in foodstuffs depend on a variety of conditions, which, as a rule, are constantly changing, so that it is practically impossible to accurately balance the nutrition for each moment of life. However, the body has special regulatory mechanisms allowing using and digesting the necessary nutrients from food in the amount that is needed at the moment. In the childhood and elderly age these mechanisms are less perfect than with an adult healthy person. Some food substances, for instance, vitamins, essential amino acids and fatty acids must necessarily come from food, because the human body is not able to synthesize them. Otherwise, the so-called alimentary diseases associated with malnutrition, such as alimentary dystrophy, etc., develop.

The human need for various nutrients and energy depends on sex, age and nature of work. Table 10.2 provides data on the daily requirements of an adult (men and women), pregnant women and nursing mothers in nutrients, energy (caloric content), and essential vitamins, depending on age and intensity of physical activity.

Table 10.2

Recommended value of food caloric content and consumption of proteins, fats and carbohydrates for adult work-capable people, depending on age and intensity of work (per day)

Nature of work	Age (years)	Men					Women				
		Caloric content (kcal)	Proteins (g)		Fats (g)	Carbohydrates (g)	Caloric content (kcal)	Proteins (g)		Fats (g)	Carbohydrates (g)
			Total	Animal proteins				Total	Animal proteins		
Mental work, minor physical load	18-29	800	1	0	03	78	400	8	3	8	24
	30-39	700	8	8	9	65	300	5	1	4	10
	40-59	550	3	6	3	44	200	2	0	1	97
Easy physical labor	18-29	000	0	9	10	12	550	7	2	3	51
	30-39	900	7	8	06	99	450	4	1	0	37
	40-59	750	2	5	01	78	350	0	9	6	23
Medium-hard physical labor	18-29	200	6	3	17	40	700	1	5	9	71
	30-39	100	3	1	14	26	600	8	3	5	58
	40-59	950	8	8	08	06	500	5	1	2	44
Hard physical labor	18-29	700	02	6	36	18	150	7	8	16	41
	30-39	600	9	4	32	04	050	4	6	12	27
	40-59	450	5	2	26	83	900	0	4	06	06
Extremely hard physical labor	18-29	300	18	5	58	02					
	30-39	100	13	2	50	75					
	40-59	900	07	9	43	46					

Notes:

1. The caloric content of a daily ration necessary for pregnant women (from 5 to 9 months of pregnancy) is, at an average, 2,900 kcal; a daily ration should contain 100 g of protein, including 60 g of animal protein.

2. The caloric content of a daily ration for nursing mothers is, at an average, 3,200 kcal, a daily ration should contain, at an average, 112 g of protein, including 67 g of animal protein.

To properly compose a diet, specialists in the field of food hygiene conditionally form 5 groups, taking into account the nature of work. The first group includes those, whose work is not connected with the expenditure of physical labor or requires insignificant physical efforts: teachers, dispatchers, secretaries, clerks, etc. The second group consists of people engaged in easy physical labor: service workers, engineering workers, agronomists, zootechnicians, nurses, workers of automatic lines at factories, etc.

The third group is composed of workers in average-hard labor: machine operators, mechanical technicians, printers, surgeons, transport drivers, tractor drivers, etc. The fourth group consists of people engaged in hard physical labor: construction workers, machine servicers, the majority of agricultural workers, workers in oil, gas, pulp and paper, and woodworking industries, riggers, etc. The fifth group comprises workers in extremely hard physical labor: miners and underground diggers, steel makers, tree fellers, bricklayers, concrete workers, shovelmen, loaders and others.

STRUCTURAL SCHEME OF THE PROCESS OF VITAL ACTIVITY OF HUMAN-SUBJECT OF LABOR

From the proposed definition of life we can make the obvious conclusion that when studying the consumer aspect of human activity, the fundamental law of transformation and conservation of mass and energy of substance and the law of transformation and accumulation of information are given the priority.

We find the processes of transformation of substance, energy and information in all manifestations of life, and this is what determines the existence of the basic laws (or signs) of life, considering which it is impossible not to notice the manifestation of cybernetic principles and methods in the functioning of biological systems, the highest form of which is the biosocial system – man. Guided by the methods of cybernetic description of existing systems, we outlined "Structural scheme of the process of vital activity of human-subject of labor" (Fig. 10.1).

In cybernetics, the notion "black box" is very popular, with the help of which researchers of various systems try to cope with difficulties of studying complex systems. The object we are studying is an extremely complex biosocial system – a human being, represented by us as "black box" – a consumer. We do not penetrate into the essence of internal processes of the transformation of substance, energy and information, and we consider the consumer from the point of his factors and results of functioning of the consumer's organism through the variety of factors emerging from the "black box" – the consumer. According to the above, from the consumer's structural cybernetic scheme we have the classification list of consumption factors comprised by the consumer.

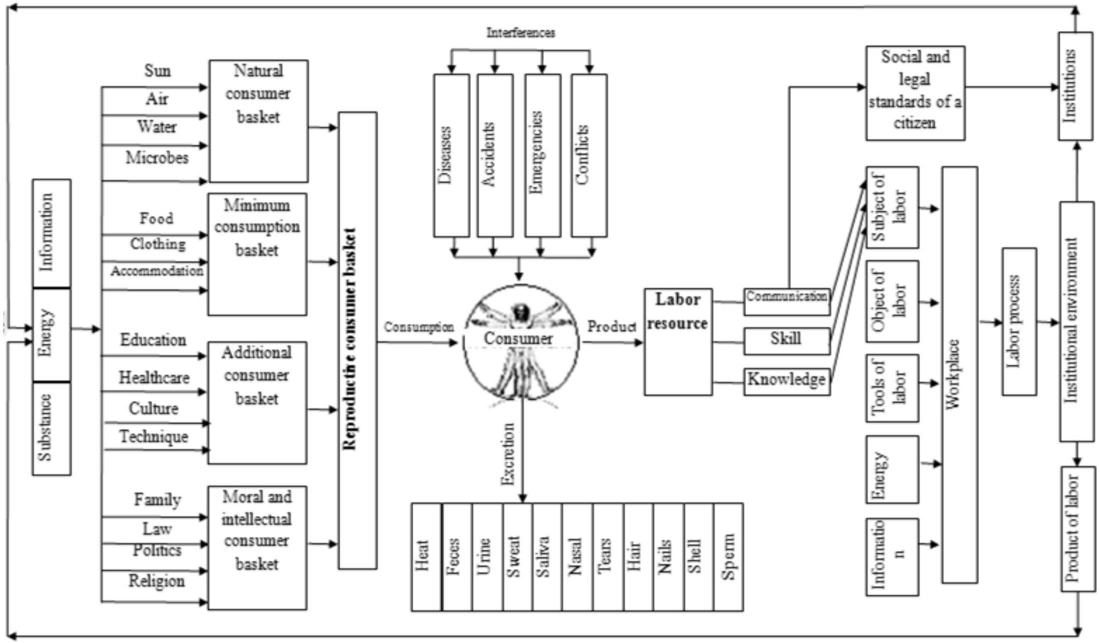


Figure 10.1. Structural scheme of the process of vital activity of human-subject of labor

The consumer satisfies:

1. Natural (innate) needs:

– solar radiation;

– air;

– water;

– microorganisms.

2. Needs for clothing (clothes, footwear, headwear):

– keeping heat;

– protecting from atmospheric and solar effects.

3. Housing needs:

– home to eat, sleep, rest;

– accommodation that protects from changing atmospheric conditions (cold, heat, atmospheric cataclysms);

– accommodation that provides constant repetition of the processes of nutrition, excretion, communication.

4. The need for means to perform the vital activity of the individual:

– means to perform the feeding process (dishes, utensils, etc.);

– means to perform excretion process (washbasin, toilet, etc.);

– means for personal safety, health preservation and protection;

– means for movement.

5. Cultural and educational needs:

– education (knowledge, skills, communication);

– social communication (information and technical communication).

6. Moral and intellectual needs:

– family (production of offspring, reproduction);

– legal (observation of social and legal standards of a citizen);

– political (development of personal consciousness of commitment to social progress and evolution of the noosphere);

– religious (belief in the usefulness of personal life and actions for own social environment).

Continuing the analysis of the structural scheme of the individual's life process from the cybernetic position of the "black box" – the consumer, it is necessary to consider the chain "consumption-excretion". Indeed, what enters any process of transformation of substance, energy, information must necessarily have an outlet, but in another transformed form. This phenomenon is clearly represented on the example of human body by the structure of various forms and types of physiological excretions. To assess the quality of life, physiological normative values were determined for each type of excretion by biology and medicine. The normal course of excretions characterizes the health of the body, deviation from the norms – the inferiority of health. Thus, the normative values of volume, composition, periodicity and intensity of excretions in medical and biological assessment of the organism quality of life become essential **indexes for the qualimetric characteristic of the individual quality of life and establishment of the standard of vital activity of human-subject of labor.**

The evolutionary significance of one kind of such excretions should be especially noted. These are the secretions of male body – sperm and female body – ovum.

Sperm (Greek sperma) is a male seed, seminal fluid that carries a male sperm cell.

Ovum is a stationary female germ cell, from which a new organism can develop as a result of sexual intercourse and ejaculation (Latin ejaculatio – ejection, emission). Based on the ejaculation processes of male sperm to connect the spermatozoon with the female ovum, a comprehensive social sphere, called sexual life, has been developed. Without taking into account the norms of sexual life based on the biological essence of ejaculation of sperm and ovum, the quality of life of the individual is inadequate. Consequently, the qualimetry of life of human-subject of labor must undoubtedly have biosocial standards of sexual desire and sexual life as the most important factor of the individual reproduction in its arsenal of methods for quantifying the quality of life.

Let's continue analyzing "Structural scheme of the process of vital activity of human-subject of labor". In cybernetics we consider systems, in the functioning of which there are always disturbances (noise, excitations). In qualimetric modeling of the processes of life quality formation disturbances are the elements of the model that conditionally take into account the probabilistic impact of values not included in the model, summarizing these random effects in the form of an additional factor in the qualimetric management of the quality of life. Disturbances occur when random (not considered in advance) effects on a viable object cannot be taken into account directly in qualimetric models and their quantitative equations.

In the structural scheme the varieties of random factors, violating the deterministic process of vital activity of the individual, are combined into several groups:

– diseases;
– accidents and injuries;
– emergencies;
– interpersonal and public conflicts.

Here it makes sense to focus on diseases. The qualimetric evaluation of life presupposes and proceeds from the postulate: **the reference consumer is always healthy.**

In the charter of the World Health Organization, health is defined as “the state of complete, physical, spiritual and social well-being”, and not only the absence of diseases and physical defects. However, any definition of health cannot claim absolute accuracy.

The health of individual and the health of population are distinguished. Human health is associated with large fluctuations in vital indexes of life activity, adaptive capabilities of the body. Between health and illness, as the opposite states, there can be the so-called condition – pre-illness, when a person is not sick yet, but the protective and adaptive forces of the organism are overstrained or severely weakened, and a harmful factor that normally would not cause a disease can cause it. In addition, health does not exclude the presence of a disease in the body that has not yet manifested itself, fluctuations in the state of health of a person or even some deviations from what is considered **a physiological norm**. In this regard, the notion **“a practically healthy person”** emerged, implying some deviations from the norm in the body that do not significantly affect the health and working capacity of the person, they cannot be regarded yet as a disease.

The state of health can be determined on the basis of subjective sensations of a specific person in conjunction with the clinical survey data, taking into account the sex, age, as well as social, climatic, geographical and meteorological conditions in which the person lives or temporarily resides.

The medical and biological concept of a disease should be briefly given. “Disease (morbus) is the disorder of normal vital activity of an organism that arose upon the action of damaging factors or is caused by developmental and genetic defects. **The person's working ability** is usually limited (sometimes lost) when the person is sick".

The causes of a disease are diverse. In addition, considering the disease as a certain deviation from normal vital activity, it should be remembered that the very concept of "norm" is extremely variable and depends on many conditions. To study the causes of the disease, biomedical science has developed a special direction of **etiology** (from Greek aitia – cause and logos – word, doctrine); the concept includes the doctrine of the causes and conditions of disease contraction and classification of the pathological state of the organism vital activity. The etiology as factors of external and internal environment, which can cause the disease, distinguishes: physical – trauma, thermal effects, ionizing radiation, atmospheric influences, etc.; chemical – acids, alkalis, various poisons, etc.; biological – pathogenic microbes, viruses, various endogenous substances; the negative effect of socially conditioned factors – poor nutrition, exhaustive work, unsanitary conditions, domestic conditions, alcoholism, drug addiction, conflict communication medium and others – have a significant impact on the disease contraction.

UNIT OF HEALTH

From the stated positions of etiology, all the disturbances indicated in the structural scheme of the individual's life process are interdependent, which allows for the qualitative analysis to proceed from the assumption that a disease is a function of external influences of physical, chemical, biological habitat on a person. The central place in the modern teaching about the causes of diseases is occupied by the postulate that the effect of the factor causing the disease is realized through the physiological systems of the organism. With the action of even strong irritators, the body strives to maintain the constancy of its internal environment. The factors of external environment constantly "test" the adaptive mechanisms of man to the limit, mobility of structures and physiological correlations underlying health. In qualimetric aspect, the adaptation that causes the non-disease should serve as the starting point for our reasoning. Therefore, when constructing a qualimetric health scale, the medical and biological concept of "a practically healthy citizen" can be taken as the standard of health of the reference person – the consumer – the creator, and assign a quantitative measure – **a unit of health** on the scale of the health quality. In the proposed scale, health will vary from one to zero. Thus, one can write down our reasoning about a person who is "healthy – sick" according to the formula:

$$R_q = 1 - M = 1 - \sum_{i=1}^{n} m_i \qquad (10.1)$$

where R_q – qualimetric state of an individual's health (R – robust in English);

M – disease factors that reduce health (Latin morbus – disease, English moribund – dying);

$\sum_{i=1}^{n} m_i$ – total of disease factors that reduce health.

Of course, the formula of qualimetric calculation of the degree of health proposed by us requires the development of special methodology for calculating the influence of various factors on the state of health. But this is a special task, which is performed based on general methodology of qualimetry applying the theory of desirability functions and reference point method.

WORKING ABILITY

The cybernetic method we used to represent the life process of the individual in the form of the structural scheme requires the consideration of the complete process of substance, energy and information transformations. If there is a target function in the system, and without it no biological formation can be considered as a system, then it must have a reasonable result of transformations. It is seen in the scheme that the labor resource, which "the consumer" acquires completing each cycle of consumption – excretion, is the result of "the black box" – consumer functioning. Thus, the transformation processes in the human body produce a reasonable product **"the human labor resource"**, his ability to commit single labor processes, which means in modern legal terms – the consumer becomes an able-bodied citizen of the country.

We proceed from the fact that the ability to work of a citizen is determined by the factors of three classes: **knowledge, skill, communication**. The class of knowledge corresponds to the social environment of vital activity called general education; the class of communication – social management (sociology).

Working ability, determined by knowledge, skill and communication becomes one of the most important (perhaps the most important) criterion in social and legal norms defining the status of a citizen of the country. The working ability can be expressed quantitatively if we take into account the world, Soviet, modern Russian theory and practice of qualification works, qualification of specialists, qualification of working ability and other methods used in the organization and standardization of labor. Qualimetric methods allow constructing a special scale of working ability for determining the quantitative value of working ability of any citizen. However, for this it will be necessary to develop reference values of working ability on the scientific basis of the concepts of **working ability and intellectuality**.

The working ability is an index of the actual manifestation of the labor resource of a citizen of a country when working at certain workplaces. Thus, the labor resource of a citizen in quantitative terms is higher than his working ability, which is manifested in practice.

The labor resource of a person is the main and basic criterion for assessing his quality of life. However, the social recognition of the labor resource is determined by the citizen's working ability. To this end, "Classifications and criteria used in the implementation of medical and social expertise of citizens by federal state institutions of medical and social expertise" have been recently developed in the Russian Federation (Annex to the Order of the Ministry of Health and Social Development of the Russian Federation of August 22, 2005 № 535).

One of the articles is called: "IV. Criteria for establishing the limitation degree of the capability of labor activity". It defines the working ability, including:

– person's ability to reproduce special professional knowledge, expertise and skills in the form of productive and effective labor;

– person's ability to carry out work at the workplace, which does not require changes in the sanitary and hygienic working conditions, additional measures for organizing work, special equipment and facilities, shifts, rates, volume and severity of work;

– ability of a person to interact with other people in social and labor relations;

– ability to motivate labor;

– ability to comply with work schedule;

– ability to organize the working day (organization of the labor process in time sequence).

The indexes of working ability are assessed taking into account the available professional knowledge, expertise and skills.

The criterion for establishing the 1st degree of working ability restriction is the health problem with persistent moderately expressed disorder of the body functions, conditioned by the disease, consequences of injuries or defects resulting in the deteriorated qualifications, the volume, severity and intensity of the work performed, the inability to continue working in the profession mastered with the possibility to perform other types of work of lower qualification and normal working conditions in the following cases:

– when performing works under normal working conditions with reduced volume of production activity of not less than twice, decreased work severity of not less than by two classes;

– when transferring to another job of lower qualification under normal working conditions due to the inability to continue working in the main profession.

The criterion for establishing the 2nd degree of working ability restriction is the health problem with persistent, evident disorder of the body functions, conditioned by the disease, consequences of injuries or defects resulting in the inability to continue working in specially arranged working conditions with the help of auxiliary equipment and/or somebody's help.

The criterion for establishing the 3rd degree of working ability restriction is the health problem with persistent, significantly evident disorder of the body functions, conditioned by the disease, consequences of injuries or defects resulting in the complete inability to work, including the work under specially arranged working conditions, or prohibition to perform work activity.

As can be seen from the list of abilities of work activities and criteria for establishing three degrees of restricting the working ability of a citizen of the Russian Federation, they are essentially qualimetric features and can be used to create a scale for quantifying the quality of "a consumer" as a **productive** citizen.

If in the citizen's standard the evaluation of social activity in the sphere of labor – working ability – is taken as equaled to one, the characteristics specified in the above instruction as limiting the individual's ability to work, then in the qualimetric scale of the quality of working ability they will be reflected as factors that reduce the qualimetric index of working ability by the corresponding value defined by the desirability function. Consequently, "Classifications and criteria used in the implementation of medical and social expertise of citizens by federal state institutions of medical and social expertise" approved by the Order of the Ministry of Health and Social Development of the Russian Federation of August 22, 2005 № 535 substantiate, from the administrative normative-legal point, the existing part of **the methodology of life qualimetry of the human-subject of labor, as well as the workplace qualimetry.**

Considering the structural scheme of the individual process of vital activity from the positions of institutional human environment, the above-mentioned classifications and criteria for determining the level of ability to work and assigning the disability group will be relevant to the social and legal norms of the citizen. First of all, the quantitative indexes of quality and subjective assessments of their utility for a particular consumer should be considered from the criterion positions of the product maker.

Concluding the schematic analysis of the structure of the individual life process, it should be noted that the individual is a fundamental element of human society. However, society is not a simple algebraic sum of individuals, it is a **synergetic sum** of individuals. Each individuality, being one of the individual elements of the set, can be considered as a probabilistic bifurcation point in synergetic field. The history demonstrates, on the fixed personalities, the significance of the individuality's activity at one or another revolutionary stage in the society evolution system. The above does not downgrade the importance of cybernetic representation of the individual's life process in the form of schematic model, since without such description of the fundamental element, it is impossible to build a general system of qualimetric analysis of the life activity quality and, first of all, to proceed with quantitative methods of analyzing "the consumer basket", which has become one of the most important criteria in modern socio-economic management.

In turn, the analysis of the consumer basket itself, without taking into account the energy-information essence of consumption and creation processes related to the human individual, will not be integral. Only the estimated monetary value of the consumer basket is very insignificant for studying the majority of processes really occurring in society. The qualimetric method based on the material and energy-information characteristic is much more solid in presenting the essence and significance of the life quality in all its state and development aspects.

In all manifestations of human life, whether it is labor, social or personal life, as we subdivide it into the spheres of vital activity (and according to other authors, an individual's labor, socio-political and cultural-everyday activities are distinguished, respectively), we consider a person, first of all, as biological system with incoming and outgoing flows of substance, energy and information. It is obvious that with this approach, the life quality is largely determined by the qualitative characteristics of these flows and their qualimetric parameters. And that there is no doubt that all life processes are also characterized by "the processes of substance and energy transformation and information accumulation".

Adopting the energy-informational concept of life and applying the classification of labor products based on it [Perevoshchikov Yu. S. Economic metrology. Labor qualimetry. Moscow: Published by All-Russian Center of Life Level, 2015. 505 pp.], we can specify the content of incoming and outgoing flows of human life processes.

Incoming flows: material and energy carriers (nutrients and energy obtained from food, system of electricity, gas, water, heat supply); objects of everyday life and other objects of the material world, which are regulators of energy exchange with the external environment and energy converters (clothes, furniture, part of household appliances, housing), sources and converters of information (part of household appliances, media, literature, information systems, computers, etc.); information itself, including that received from people.

Outgoing flows: derivative products of the substance, which got into the body; energy transferred into the external environment in the form of heat and spent for the fulfillment of labor processes; use of the thesaurus (accumulated knowledge) in the labor process and its transfer in the process of communication.

Thus, we can state that the energy-information resource of an employee materializes in the products produced by him, the subsequent consumption of which allows him to qualitatively and quantitatively change his energy-information resource (Figure 10.2).

All that has been said confirms that the definition of life as a metabolic process given by F. Engels has not lost its meaning and preserves the status of a fundamental scientific concept, but it must be supplemented with organizational, energy, information and evolutionary components. Recent achievements in various fields of science allowed us to do this. **Life is a way of existence and evolution of a system of protein bodies, manifested in the form of processes of transformation of substance and energy, and transformation and accumulation of information.**

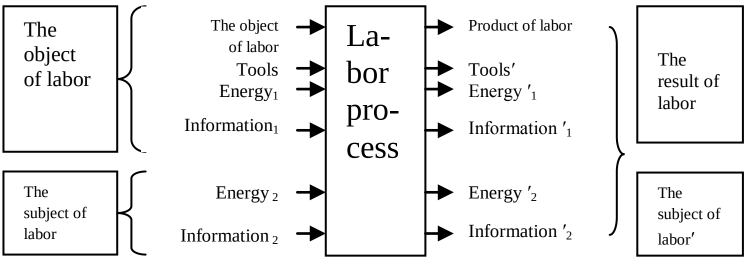


Figure 10.2. Scheme of energy-information interaction of man and environment in the labor process
(performed with the participation of V. A. Belyakov)

11
Workplace – primary productive unit in the sphere of labor

PRIMARY ERGONOMIC LINK PRODUCTION SYSTEMS

A single labor process, no matter how specific it could be, can always be represented only as a material-tangible, energy and information process. Any process (Latin processus – passage, advancement) is a successive change of states, a close link between successive stages of development, which represent a continuous unified movement. The change of states arises as a result of the interaction of individual constituent elements that occur in space and in time. In case of labor processes, a workplace is such space.

The workplace is given dozens of different definitions, which have common and different formulations. The founders of Scientific Organization of Labor (SOL) (A. K. Gastev, P. M. Kerzhentsev, O. A. Yermansky) did not have a clearly defined definition of the workplace, because it was considered intuitively clear as the place where the work is done. With the improved scientific analysis of the organization of labor and production, disagreements and discussions between various specialists and representatives of the same profession have increasingly arisen. As the work on the organization of production expanded, so did the terminology associated with this work. Over time, an increasing number of people involved in the production management came to the conclusion on the necessity of clear definition of the terms in the field of production organization and creation of uniform terminology.

Therefore, in 1943 the Committee for Standardization of Works of the Production Management Section of American Society of Mechanical Engineers decided to concentrate its efforts on the unification of terminology.

In the materials of the Committee in 1950-1956 the following definition of the term “work station, work place” was given: “Part of the production site where the worker performs the work assigned to him, comprises the space necessary for placing equipment and attachments (bench, machine, all racks, containers, transportation devices, etc.) and materials” [Engineering psychology in the application to the equipment design / Trans. from English. Ed. by B. F. Lomov and V. I. Petrov. Moscow: Mechanical Engineering, 1971. 488 p. P. 449].

Due to this new period in SOL development in 1960s, the need for standardization of terms in the field of labor organization became evident. In one of the first textbooks on SOL, the following definition was given: “A workplace is a zone of labor actions of a worker or a group of workers (brigade), fitted up and equipped with everything necessary to fulfill a production task. Apart from the worker himself, the necessary items and tools used to accomplish certain elements of the production process, as well as the necessary means of equipping the workplace (production furniture, vehicles, etc.) are placed at the workplace” [Dubrovsky Yu. N., Melnov M. A., Tsetlin B. V. Scientific organization of labor. Moscow: Economics, 1974. 174 pp.].

It seems that the word combination “worker’s zone of labor” is unsuccessfully applied in the definition. First, “zone” is the Greek word, meaning “belt”, “region”. Probably, it is preferable to replace the word “zone” by the word “space”. If we take into account that the workplace is an elementary part of the production unit, it would be possible to characterize the workplace as an elementary space of production, or as an elementary production space.

It is incorrect to define the workplace only as a field of labor, since according to the accepted definitions the state of “sitting” or “standing at the workplace” are not a labor activity. The place of fixing an electric bulb on the ceiling cannot be characterized as the zone of worker’s labor. It will be more correct to say that the workplace is an elementary production space in which something is placed.

In GOST 19605-74 (State Standard), the following definition is given: “Workplace is a zone equipped with the necessary technical means, in which the labor activities are fulfilled by the executor or group of executors, performing one work or operation together”. Not labor activity but only its part – a single labor process, is fulfilled at the workplace. If we separate a job from an operation, we introduce a different meaning into each concept, in which case they must be also defined in the standards. It is well known that there is no work without operations and the operation cannot exist beyond the work.

The workplace is also equipped, in addition to technical means, with mechanized auxiliaries, technical documentation, lubricants, electrical energy supply, etc. – labor means, in general.

In connection with the above remarks, we will attempt to give the following definition: **the workplace is an elementary part of the production space in which the placed means of labor, objects of labor and subject (subjects) of labor are interrelated for the implementation of single labor processes in accordance with the target function of obtaining the product of labor.**

With this definition of the workplace, its characteristic concepts: means of labor, objects of labor, subject of labor, process of labor, product of labor are scientific categories of economic theory.

The organization of labor as a science studies single labor processes based on the provisions of economic theory, therefore, the definition of a workplace through its categories and concepts is legitimate and reliable. Further, when we say that the workplace is an elementary part of the production space, we emphasize that the workplace is an element, indivisible, in production sense, part of something whole, namely, the production of products. Here there is an objective necessity of deciphering the political economic concepts: **means, object, subject, product of labor** through the concepts and categories of production organization. For example, when we clarify the notion "means of labor", we enumerate specific forms and properties: technological equipment, technological accessories, cutting tools, measuring tools, lubricating and cooling materials, organizational accessories, etc. In turn, the concepts and categories of the science of production organization are determined and specified through the concepts of production technology. For example, technological equipment is specified through its technological varieties: screw-cutting lathe, vertical milling machine, hydraulic press, etc.

In the above definition of the workplace, the allocated means, objects, subject of labor are characterized as interrelated for the implementation of single labor processes. Interrelation is a characteristic feature of systemic formations. Consequently, the workplace is not simply the placement of individual elements, but such arrangement that forms a system through the interrelation. From cybernetics and general theory of systems it is known that “a system is a set of elements that are related and connected with each other, which forms certain integrity, unity”. Thus, the elementary part of the production space, in turn, appears as the interrelated set of elements (even smaller ones, figuratively speaking, in comparison with the previous elements).

In addition, in the above definition, all elements of the workplace are interrelated in accordance with the target function of obtaining the product of labor. The development and formulation of the target function is the area of information modeling and systems analysis that deal with cybernetic systems and information theory.

THE FIRST SINGER OF THE WORKPLACE

Alexey Kapitonovich Gastev (1882-1941) historically became the first crier (public herald, publisher, prophesier, catechizer, proclaimer by V. I. Dal) of the workplace theory in Russia. The pathos presentation of his theory of the workplace is permeated with his activity on the organization of the Central Institute of Labor, followed up by the Research Institute of Labor. He is indicated in the encyclopedia as a Russian, Soviet poet and scholar. The collection of his poems “Poetry of the Work Impact” (1918), “Pack of Orders” (1921), the publicistic book “How to Work” (1921), the complex of scientific and practical researches on rational organization and culture of labor – act as a prelude to the workplace economy, i.e. (in the terminology of economic liberals) – to the nanoeconomics as the primary step in the whole system of transformations of substance, energy, information in the vital activity of an individual “physical person” and global “legal entity”.

Production analytics. Introducing the notion of "production analyst", A. K. Gastev explains its meaning from his theory of labor settings.

"First of all, we will try to establish some concepts and classifications on the basis of which we will give the analytical construction".

Modern literature, dedicated to the study of labor, freely operates with such concept as **labor processes**. Needless to say, this term has become very firmly established in pedagogical and popular literature. But, by the way, this term cannot denote the exactly established, defined concept.

It is necessary to do extremely difficult, painstaking analytical work in order to approach certain objects when studying labor, the objects that are equally convenient for both methodical work and for conducting a so-called natural experiment, whether it be in the laboratory or in the factory workshop. Meanwhile, without serious analytical work, it is impossible even to accurately describe any kind of labor process. And we can hardly claim now to give a satisfactory analytical study of labor processes and their individual elements. But we can, however, attempt to disclose the nature of analytical techniques that would be acceptable to us in the analysis. With all attempts to analyze the labor processes that have been done up to now, most of the time they took those concepts that had been developed long ago. Meanwhile, modern industry in its technical and industrial area, as well as crafts, are constantly evolving, replacing one name of the object of reception with another. Therefore, we face the task of revealing these labor processes, drawing up a kind of graph of the basic elements of these labor processes. And if it were possible to draw up at least an incomplete graph, this would serve as a serious prerequisite for all sorts of experimental and practical work **in the field of labor science** (emphasized by Yu. P.) [Gastev A. K. Labor settings. Moscow: Economics, 1973. 343 p. P. 104].

If we set ourselves not only an academic, but also a utilitarian goal – to create the system of rational, rapid and mass education or, in other words, the rational, rapid and mass formation of certain labor movements, then the following areas have to be seriously analyzed.

First of all, it is necessary to analyze various types of **technical and organizational settings**, those settings that are expressed in the form of a workplace, tool settings, which have to be worked with directly (whether it is a machine or human hands), and, finally, to analyze various kinds of devices, which play the role of auxiliary technical and organizational settings.

This is one area that we could call a technical and organizational area. The second area will deal directly with a person and exactly with that sphere that is subject to our immediate observation. This is **the area of movements** or, better to say, the area of various biomechanical states, since they are expressed in certain tuning of nerves, certain state of bones and, finally, of muscles and joints. It requires a serious analysis not only of the movements themselves, but also of those **biomechanical states** on the basis of which this or that movement is made.

This analytics is followed by the analytics of **energy states** – both the acquisition and consumption of the energy that goes through the human body.

Consequently, we are facing the problem of measuring the work of heart, lungs, blood pressure and the entire metabolism sphere. This area is more difficult than the biomechanical one. If in the biomechanical area everything, with the exception of nervous system, can be subjected to direct measurement and even produce a graphic record, in the area of energy states, although much studied at the moment, unfortunately, the problem of direct automatic display (record) of all these data during the process of work (especially in the field of blood pressure and metabolism) is not solved yet.

But the most unknown area is the area of internal **psychological states**, the so-called experiences, since they are accessible to us only in the process of introspections or questionnaires. This type of disclosure of labor processes is extremely low-valued, because it carries a huge amount of subjective element in itself.

But it would be wrong to think that such side of labor processes as movement is an ungrateful and low-valued material for analysis. If we only limited ourselves to studying this aspect of movements in labor processes and could have subjected them to careful analysis, we could still achieve enormous results in this way. Let’s say even more – the movements are the basis for determining all states, if we remain at the level of modern science, which absolutely everything, both human energy and **psychological state, brings to only** one problem, **the problem of movement.**

In any case, if one deliberately talks about analysis under the present state of science, it is necessary to concentrate the attention mainly on one side of these processes – on the movement.

TARGET FUNCTION IN WORKPLACE ORGANIZATION

There is a whole number of definitions of the concept “system”, which, with some conventionality in economic and mathematical studies, are divided into three groups. **The first**

group of definitions considers the system as a complex of processes and phenomena, as well as the links between them, existing objectively, independently of the observer. The task is to distinguish this system from the environment, i.e., to determine its inputs and outputs (then it is considered as “a black box”) as minimum, and as maximum – to analyze its structure (to structure), to clarify the functioning mechanism, and, based on this, to act on it in the right direction. Here the system is the object of research and management. **The second group** considers the system as an instrument, way of investigating processes and phenomena. The observer designs (synthesizes) the system as some abstract representation of real objects, therefore, the concept of system almost merges with the concept of model. **The third group** of definitions is a kind of compromise between the first two. The system here is an artificially created set of elements (for example, groups of people, technical means, scientific theories, etc.), designed to solve a complex organizational, economic, technical problem. The system is a real object and, at the same time, the abstract representation of the relations of reality. It is in this sense that the science of system engineering understands the system [Hall A. D., Feijin R. E. Definition of the concept of system // Investigation on the general theory of systems. Moscow: Progress, 1969. 376 pp.].

Proceeding from the foregoing, let us repeat once again the definition of the system given earlier by us: **system is a set of elements interconnected in such a way that the impact of the environment (another set) on some part of the elements leads to a change in the state of the whole set**.

Taking into account the technological principles of forming workplaces and the above systemic considerations, it can be asserted that material-energy and psychophysiological information processes take place in the workplace, in which there is a manageable and managing parts. The manageable part is the system: equipment-accessory-tool-part (EATP), and the managing part is a worker of certain profession with certain knowledge and experience. Based on the theory of regulation in the system with feedback, the workplace functioning can be demonstrated with the diagram (Figure 11.1).

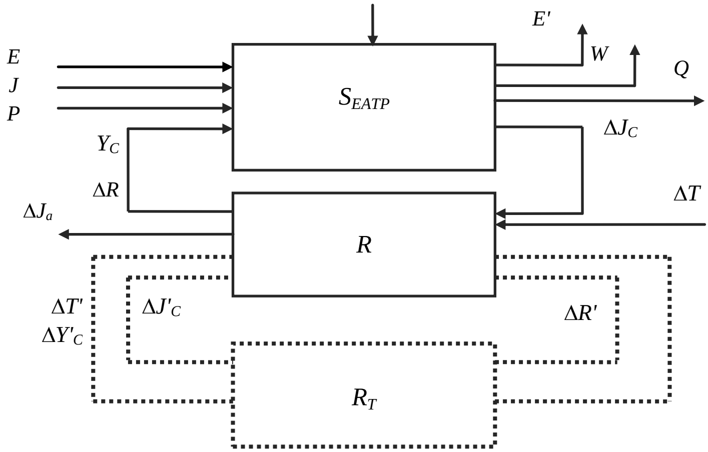


Fig. 11.1. Block diagram of the workplace functioning

S_{EATP} system at the workplace is managed by the worker *R*, who receives the instructions of the foreman (headman), work order, technological map, operational-normalizing card – in short, the worker receives the primary information from the higher level of management – ΔT. In addition, the worker *R* has knowledge, skills, i.e., speaking the language of information theory – his own thesaurus (a priori information) – R_T, the value of which varies in accordance with the law of experience accumulation.

In R_T scheme the corresponding bonds $\Delta T'$, $\Delta J'_C$, $\Delta R'$, $\Delta Y'_C$ are indicated with dashed lines, since the allocation of the knowledge block, process of information perception and its comparison with the thesaurus (memory) in relation to the workplace can be represented only conditionally, i.e., perception, reception, processing, transfer of information is the internal attribute of the subject of labor, acquired, speaking psychophysiological language, as a result of sensorimotor reaction.

The worker in the process of management (regulation) of the labor process constantly receives information ΔJ_C on the results of S_{EATP} system operation. The fruitful result of the system operation, the product of labor, is designated as Q. At the input of S_{EATP} system, we have the object of labor – workpiece P, energy E (for example, electrical energy) and information J.

From the external environment S_{EATP} system is affected by interference ε, for example, case-chilled crust on gray iron casting, unexpected electrical current switch-off, and the like.

The workplace system functions according to the following interrelated chain: worker R receives the primary information (task) ΔT, compares it with the information available in his own memory, activates his own forces ΔY_C and directs them to separate parts of S_{EATP} system, i.e., he manages the interrelated functioning system of material-energy processes occurring in the chain: equipment-accessory-tool-workpiece (part). As a result of the operation of S_{EATD} system, workpiece P is converted into product Q – item and waste product W; energy E in EATP system undergoes transformation (it is converted into mechanical force, heat, sound) in E'; information ΔJ_C on the results of the functioning of EATP system is perceived by worker R who sends the message about his activity ΔR to the superior level (foreman, controller, accountant, headman); from this moment the process is repeated again, but with another subsequent copy of part P. Each time, the above cyclic process can be stereotyped (the same) or different. The process takes place in space and time and has its own, inherent in this workplace, **algoheurhythm**, i.e. the combination of algorithmic and heuristic rules for the system functioning. Since the algoheurhythm exists, it can be described by appropriate informational and mathematical symbols, **that is, a technical-economic-mathematical or, as it should be, engineering-qualimetric model of the workplace can be created.**

In the definition of the workplace, we affirm that single labor processes are carried out at the workplace in accordance with the target function of obtaining the product of labor. The target function is usually "a formal expression of the system purpose". In relation to the workplace, the target function should formally (mathematically) link the output of the workplace system and the input, i.e., it is possible to write down the main goal of obtaining product Q as the function of all necessary factors within the system of workplace functioning factors: $Q = \varphi(S) = f(P, \Delta T, E, \Delta Y_C, W, E')$, where S – resources; P – objects of labor; ΔT – task (primary information); E – energy sources; ΔY_C – psychophysiological efforts (managing actions) of the worker; W – wastes in production (wastes from the object of labor and operational wear of the means of labor); E' – converted (scattered) energy.

The functional dependence did not include interference ε, because (as can be seen from the diagram), their influence on the results of EATD system operation is not controlled by worker *R*. Only some or all of the higher levels controlling coupled systems can manage (study, prevent, legalize) interference ε, therefore, the impact on possible interference should be organically included in the primary information (task) – Δ*T*.

It is well known that the mass of substance and energy in the transformations do not disappear, but they are only converted from one form into another.

From the workplace block diagram it is seen that the equality $Q + W + E' = P + E$ should be observed.

Let us transform the equation $Q = (P + E) - (W + E')$.

We divide both sides of the equality by $(P + E)$:

$$\frac{Q}{(P+E)} = 1 - \frac{(W+E')}{(P+E)}. \qquad (11.1)$$

We designate $\frac{Q}{(P+E)} = \eta$, $\frac{(W+E')}{(P+E)} = \varepsilon$, then $\eta = 1 - \varepsilon$.

It is obvious that $\varepsilon = \frac{(W+E')}{(P+E)} \le 1$, whereby $0 \le \eta \le 1$.

The ratio $\frac{Q}{(P+E)} = \eta$ is called the Q-factor of the workplace functioning, which is equivalent to the concept of “efficiency coefficient” in the processes of energy conversion. Is it possible to control the change in the quality level of the workplace? Let us assume that all products are rejected because of non-compliance with technical conditions. This can be the result of many technical, technological, organizational hindrances not depending on the worker, as well as interference caused by various omissions of the worker himself, in short, due to the low organization of labor. We write down this argument mathematically $\eta = f(\Delta T, \Delta Y_C)$, where ΔT – primary information coming in the form of the production assignment with the entire set of documentation and list of material and technical supply of the workplace with all the necessary resources; ΔY_C – managing effects of the worker.

As can be seen from the functional dependence, **the Q-factor of the workplace functioning is the Q-factor of the workplace management.**

In combination with the form of labor organization, the requirements of the Labor Code (Art.22. Rights and duties of an employee), consciousness and scrupulosity constitute the main qualitative characteristic of labor organization at the workplace. Discipline provides for the conscientious performance of their duties by employees on the rational use of tools and objects of labor, working hours, observance of routines, sequence and methods of processing labor objects, improving its productivity and product quality, observing health and safety regulations. Consequently, intra-company labor discipline is a broad concept. If its meaning is narrowed to the level of an individual and collective (brigade) workplace, then it is possible to consider industrial discipline as consisting of three components: labor discipline, technological discipline and managerial discipline.

Authors of the book [Kostakov V. G., Rutgaizer V. M. The human factor: employment, welfare. Moscow: Politizdat, 1981. 238 p.] in their time, distinguishing between the concepts of “labor discipline”, “production discipline”, “technological discipline”, argue that “labor discipline is a broader concept and includes production discipline and its component – technological discipline”. They do not specially distinguish the managerial discipline.

But we must proceed from the obvious fact that any production is an aggregate of workplaces and single labor processes, technological and managerial processes that are taking place. Therefore, we propose to distinguish a special form and component of the production discipline – managerial discipline.

The foregoing can be represented by the following analytical dependence: $D_P = f(D_T) = \varphi(D_Y)$, i.e., labor discipline (D_P) is a function of technological discipline (D_T), which, in turn, is a function of managerial discipline (D_Y). The aggregate (D_P, D_T, D_Y) constitutes the content and sense of production discipline. Hence it is appropriate to express the Q-factor level of the workplace management $\eta = f(\Delta T, \Delta Y_C)$ through the level of the production discipline state.

The tasks of strengthening the production discipline can be formulated based on **the universal law of working time economy, i.e., the law of labor economy:**

a) implementation of living labor economy by eliminating downtime and absenteeism, reducing manual labor, labor costs of highly qualified specialists for jobs that do not fit their qualifications, reduce the unplanned movement of workers;

b) struggle for the economy of materialized (past) labor by eliminating downtime for machinery and equipment for various reasons, especially for repairs, ensuring timely development of capacities and increasing efficiency of all types of machinery, mechanisms and equipment, eliminating over-expenditure and loss of materials, tools and accessories;

c) desire to optimize managerial information, streamline the document workflow, improve the reliability of statistical data, complete provision of production managers and workplaces with engineering-technical and organizational and economic information;

d) economy of the future labor by improving the quality of engineering design and, on this basis, obtaining optimal capacity of enterprises, their expedient placement and effective operation, and improving qualimetric indexes (quality indexes) of products.

In the practical use of the previously mentioned ratio, the problem of incompatibility of dimensionalities *Q*, *P*, *E*, *W*, *E'* arises, since the product of labor is characterized by its dimensionalities, and the objects of labor and energy have dimensionalities that are not comparable with the product, the production wastes and scattered energy have their respective measurement units. Of course, in principle, it is possible to find fairly acceptable methods for the equivalent translation of dimensionalities, but there are simple and less labor-intensive methods for determining the Q-factor of the workplace.

The foregoing ways of struggle for labor economy lead directly to the growth of labor productivity, and, consequently, introducing them into the workplace model through the notion of Q-factor of management and production discipline, it is possible to reflect the basic task of inter-company labor organization quantitatively and at each workplace.

It follows from the aforementioned that the state of production discipline can be characterized by the degree of effective use of working time of all workers and expressed quantitatively by the coefficient of the state of production discipline:

$$K_{pd} = K_{lb}\, K_{td}\, K_{md} =$$
$$= \left(1 - \frac{t_{in}}{T_{sh} n}\right)\left(1 - \frac{t_1}{T_{pl} n_1}\right)\left(1 - \frac{t_T}{T_{tech}}\right)\left(1 - \frac{t_m}{T_{pl} n_2}\right), \quad (11.2)$$

where K_{pd} – coefficient of the state of production discipline; K_{lb} – coefficient of the state of labor discipline; K_{td} – coefficient of the state of technological discipline; K_{md} – coefficient the of state managerial discipline; t_{in} – total inter-shift losses of working time caused by violations of the work schedule; T_{sh} – work shift duration; n – number of workers supervised; t_1 – total day-to-day losses of working hours caused by violations of the work schedule; T_{pl} – planned fund of working time of one worker for the considered period; n_1 – number of workers in this unit, as stipulated in the plan; t_T – total losses of working time caused by violations of technological discipline; T_{tech} – total standardized technological labor intensity of works in this unit, as stipulated in the plan; t_m – total losses of working time caused by violations of the managerial order; n_2 – number of employees in this unit, as stipulated in the plan.

With this approach of quantitative expression of the Q-factor of the workplace (workplaces) management through the coefficient of the state of production discipline, we come to the necessity of classifying the losses of working time and, for this purpose, the need to study the experience of their recording at industrial enterprises and divisions, especially in compliance with the requirements of ILO and Labor Code of the Russian Federation, as well as the development of forms of labor organization at workplaces. But this is a special scientific problem, for the solution of which certain prerequisites are set forth in the work [Management of work in the team: Reference and methodological manual. / Ed. by Yu. S. Perevoschikov. Izhevsk: Udmurtia, 1983. 220 pp.].

QUALIMETRIC CRITERIA OF THE WORKPLACE

In physics, the ratio of the amount of work and time, during which this work is done, is called power and is measured in watts and kilowatts. In economy of an industrial enterprise, the division of the output of products by the operation time of equipment at this workplace is called the productivity index of the equipment [Voskresensky B. V., Palamarchuk A. S. Reference-book of the economist-machine builder. Moscow: Mechanical engineering, 1977. 37 pp.; Kamenitser S. E. et al. Reference-book of the economist of an industrial enterprise. Moscow: Economics, 1974. 326 pp.].

The study of methodological problems of determining the production capacity of industrial enterprises and their subdivisions is a special scientific direction, and there is no possibility to outline the problems and ways of their solution in this work. For a long time, we have carried out the research work to improve the technical and economic planning of multiproduct productions based on qualimetry fundamentals (the science of measuring product quality). Among the technical and economic indexes, the production capacity of the workplace is also considered.

By analogy with the notion of physical power ($N = A / t$), it is proposed to define the production capacity as the ratio of the product manufactured at the workplace to the time during which this product was manufactured at the given workplace ($M = Q / t$).

In this case, the ratio of production capacity to physical power can be called the productivity of equipment, i.e.

$$P_{eq} = \frac{Q / t}{A / t} = \frac{Q}{A}. \qquad (11.3)$$

By dividing the amount of product output (Q) at the workplace by the labor input (L_{in}), which can be defined as the product of time (t) by the labor intensity coefficient (C_{li}), we get the expression of living labor productivity (P_l), i.e.,

$$P_l = \frac{Q}{L_c} = \frac{Q}{C_{li}t} = \frac{Q}{C_{li}C_c t}. \qquad (11.4)$$

What index can be the criterion of process management at the workplace? It should be such an index, which does not contradict, but, on the contrary, proceeds from the general criterion of the optimality of management in national economy. This criterion for production, from the standpoint of evaluating the inter-company production functioning, is known to be labor productivity.

It can be seen from the structural scheme of the workplace that not only the living (creative) labor of the worker participates in the creation of the product of labor, but also the previous labor (T_{pr}) in the form of the object of labor (P), machine, device, tool, mechanized auxiliaries and energy. Therefore, it is necessary to include past work (T_{pr}) in the index of labor productivity at the workplace, then

$$P_l = \frac{Q}{\left(L_c + T_{pr}\right)} . \qquad (11.5)$$

The proposed formula is not new in itself, it is about whether it is possible and how to apply the above formula for practical calculations of labor productivity at certain workplaces?

Of course, in future, apparently, both living and past labor in labor-hours will be taken into account.

Unfortunately, at present there is no registration of labor costs in terms of products, but we have a whole system of calculating the production cost and even the cost of a technological operation. Consequently, the cost of technological operation (C) is reflected with one or another error in each particular case of the costs of living and previous labor, therefore, the following expressions can be considered as equivalent ones:

$$\frac{Q}{L_c + T_{pr}} \Leftrightarrow \frac{Q}{W + \sum_1^n C_i}\ , \qquad (11.6)$$

where W – wages of the worker, rub.;

C_i – costs at the workplace for the i-th item of expenditure, rub.;

$\Leftrightarrow$ – equivalence sign;

$i = 1, 2, 3, ..., n$ – number of cost items in the estimate for the given workplace.

Since Q is the same in the right and left parts, then

$$\left(L_c + T_{pr}\right) \Leftrightarrow W + \sum_1^n C_i\,, \qquad (11.7)$$

We introduce the equivalence coefficient

$$\mu = \frac{(W + \sum_{i=1}^n C_i)}{\left(L_c + T_{pr}\right)}\ . \qquad (11.8)$$

Let us write the equality $\mu\left(L_c + T_{pr}\right) = (W + \sum_{i=1}^n C_i)$.

We can say that in the period between monetary reforms, the coefficient of equivalence applied to wholesale prices of enterprises can be taken as constant. With this assumption, the productivity of labor at the workplace is determined by the ratio of product output Q and cost of living and previous labor in monetary terms.

$$P_l = \frac{Q}{\left(W + \sum_{1}^{n} C_i\right)}. \qquad (11.9)$$

There remains the problem of quantitative measurement of products produced at the workplace. If a single type or an unchanged set of types of products (parts) is continuously produced at the workplace for a long time, then the output volume can be measured in pieces or sets of parts. However, the majority of jobs are multiproduct, diversely-product, so, in practice they resort to the methods of calculating the output through labor expenditures and costs expressed in money. But, as can be seen from the formula, the costs do not characterize the very essence of consumer properties of products, and it is senseless to divide the production costs by the production costs.

Based on the principles of qualimetry, all products can be represented quantitatively through the use of mathematical model that connects various parameters, characteristics and properties of products into a single integral quality criterion, will be called the general qualimetric index. Consequently,

$$Q = \sum_{1}^{w} P_i \, K_{q_i} , \qquad (11.10)$$

where P_i – value of the parameter of the i-th type of the products manufactured at the workplace;

K_{q_i} – general qualimetric index of the i-th type of the products manufactured at the workplace;

i = 1, 2, 3, ..., w – serial numbers of the products manufactured at the workplace.

Thus, the formula makes it possible to quantify the **qualimetric index of products** manufactured at the given workplace as the sum of products of the main parameter values of the types of products by their total qualimetric index.

The main parameters of the products manufactured at the given workplace can be the quantities having the following dimensions: piece, kg, m, m^2, m^3, etc.

The general qualimetric index quantitatively reflects what quality this parameter of the product possesses (what it is filled with), i.e., what registered characteristics and properties are acquired by products at the workplace. When we multiply the main parameter by the qualimetric index, which has the quality dimensionality – quali, then we get a quali-parameter, e.g., quali-piece, quali-kilogram, quali-meter, quali-square meter, quali-cubic meter, quali-kilogram-meter, quali-calorie, etc.

In turn, the general qualitative index can be expressed as the product of particular qualimetric indexes, i.e.,

$$K_q = K_1 \cdot K_2 \cdot ... \cdot K_m = \prod_{1}^{m} K_j \ , \qquad (11.11)$$

where K_j – qualimetric index of the j-th registered characteristic, property characterizing the quality of the manufactured products at the given workplace from one particular j-th side.

Each particular qualimetric index is a dimensionless coefficient that reflects the measured or quantitatively expressed value of a certain characteristic, property inherent in the given product, i.e.

$$K_j = \frac{f(q_i)_j}{f(q_\delta)_j}, \qquad (11.12)$$

where q_i – measured or estimated value of the j-th characteristic, property for the i-th copy of the product manufactured at the given workplace;

q_δ – measured or quantified value of the j-th characteristic, property for the δ-th copy of the product manufactured at the given workplace, taken as the base.

Functional expressions in the numerator and denominator of formula K_j have the same dimensionalities, therefore, the value of particular qualimetric indexes becomes a dimensionless coefficient.

The type of functions is derived by the methods of mathematical statistics (applied regressive and correlative analyses) by means of appropriate processing of the collected statistics on the effect of a characteristic, product properties on the socially necessary (standard) time of its production at the workplace, i.e., the following functional dependence is revealed: $t_j = \varphi(q_j) = A_j \cdot q_j^{a_j}$, and the qualimetric index will be expressed as follows:

$$K_j = \frac{(A_i)_j (q_i)_j^{a_j}}{(A_\delta)_j (q_\delta)_j^{a_j}} = \left(\frac{q_j}{q_\delta}\right)^{a_j} = b_j^{a_j}, \qquad (11.13)$$

since $A_j = A_\delta$ = const for the given kind of function.

It follows from the foregoing that the general qualimetric index of products manufactured at the workplace will be expressed by the following function:

$$K_q = \prod_1^m K_j = A \cdot b_1^{a_1} \cdot b_2^{a_2} \cdot \ldots \cdot b_m^{a_m}. \qquad (11.14)$$

This function is nothing more than **production function** reflecting the product quality (its qualimetric index).

In economic and mathematical studies, multiplicative forms of production functions are widespread. Their advantage consists in the following: if one of the multipliers is zero, then the result goes to zero. It is easy to see that this realistically reflects the fact that, in most cases, all analyzed primary resources participate in production and without any of them the product output is impossible. The b_i multipliers from the first to the *m*-th can have different contents depending on which factors influence the overall result (release). The exponential coefficients show that the share in the growth of the final product, which each of the multipliers brings in. If the sum of the coefficients is one, this means the uniformity of the function: it increases proportionally to the growth in the amount of resources. But it is also possible that the sum of elasticity coefficients (parameters of the production function) is greater than one. This shows that an increase in costs leads to the disproportionate increase in the output. The development of the production function method cannot be considered complete; the studies on its generalization and refinement are conducted, in particular, in the direction of developing special production functions that meet the specific conditions of individual industries and enterprises, for instance, engineering-qualimetric models of the workplace.

According to available literary sources, it can be claimed that there is no production function for the workplace, in the sense we have proposed, so the qualimetric approach to the calculation of the product output volume opens great opportunities for economic and mathematical modeling at the workplace level – the primary element of production systems. The derived equation of the production function of the workplace is the contribution to the development of the theory of production functions. The production function of the workplace is called **the qualimetric equation of the workplace**.

We have developed and tested the production functions of individual and collective (brigade) workplaces for trial, experimental, tool shops engaged in the production of parts by cutting, for sheet-stamping, forging, hot-stamping, casting shops, shops of steel shaped profiles.

In the formula of labor productivity, the product Q can now be expressed quantitatively through its qualimetric equation

$$P_l = \frac{\sum_1^r m_i K_{q_i}}{W + \sum_1^n C_i} \ . \qquad (11.15)$$

There is a definite correlation between the productive labor power and labor productivity. Considering this, it is possible to express the productive labor power with reference to the workplace $P_p = \varphi(M, P, E, O, \eta)$, where M – mechanical loading at the workplace; P – power loading of labor; E – electronic loading of labor; O – technological equipment of the workplace; η – Q-factor level of the workplace functioning, depending on the state of management emanating from the higher authority (ΔT) and the skill level and efficiency of the worker (ΔY_C).

Using the methods of mathematical statistics and expressing quantitatively each of the factors, one can obtain the production function that establishes the dependence of labor productivity on the factors that form the value of the productive force of labor at the given workplace, i.e., P_l = f(P_p) = $B \cdot \eta \cdot \cdot M^{\beta_1} \cdot P^{\beta_2} \cdot O^{\beta_3} \cdot E^{\beta_4}$, then

$$P_l = \frac{\sum_1^r \grave{o}_i K_{q_i}}{W + \sum_1^n C_i} = B \cdot \eta \cdot M^{\beta_1} \cdot P^{\beta_2} \cdot O^{\beta_3} \cdot E^{\beta_4}, \quad (11.16)$$

or

$$\frac{\sum_1^r \left[P_i \cdot \left(A \cdot b_1^{a_1} \cdot b_2^{a_2} \cdot \ldots \cdot b_m^{a_m}\right)\right]}{W + \sum_1^n C_i} = B \cdot \eta \cdot\cdot M^{\beta_1} \cdot P^{\beta_2} \cdot O^{\beta_3} \cdot E^{\beta_4}.$$

This equation, we believe, is the main conclusion from the whole previous study. It is a technical-economic-mathematical **engineering-qualimetric model of the workplace and serves as the target function of ergonomic optimization of the workplace under the actual and project organization of labor,** which we defined as a field of people's practical activity in designing and implementing projects of single labor processes and managing them to improve labor productivity.

To sum it up, the derived target function is only the concrete expression of the social target function applied to the workplace.

1. Qualimetrically calculated volume of products

$$Q = \sum_1^r P_i \left(A \cdot b_1^{a_1} \cdot b_2^{a_2} \cdot \ldots \cdot b_m^{a_m}\right). \quad (11.17)$$

2. Costs (expenditures) of living and previous labor

$$L_c + T_{pr} = \mu \left(W + \sum_1^n C_i\right). \quad (11.18)$$

3. Resources of production (productive labor force)

$$P_F = B \cdot \eta \cdot M^{\beta_1} \cdot P^{\beta_2} \cdot O^{\beta_3} \cdot \mathring{A}^{\beta_4}. \qquad (11.19)$$

4. Q-factor (efficiency) of production management

$$\eta = f(\Delta T, \Delta Y_C) = K_{lb} K_{td} K_{md} \qquad (11.20)$$

Consideration of these indexes in complex leads to the expression of the dependence of product output on resources and Q-factor in public system, i.e.,

$$Q = \eta P_F (L_c + T_{pr}). \qquad (11.21)$$

If Q-factor equals zero ($\eta = 0$) the product is zero. At $P_F = 0$, also $Q = 0$, i.e., without resources there is no product output and, moreover, from the production function of resources it is evident that the absence of one resource (one type of resource is zero) is sufficient, as the entire value of resources becomes zero. **There must be all necessary resources!** If the costs of living labor are zero, then the production functions only at the expense of previous labor costs, which means full automation of the workplace. In the absence of the previous labor costs, the products are manufactured only by living labor – completely manual labor.

12
Evolution instead of revolution

Although in this book (Margaret Kennedy “Money without interest and inflation”), monetary, land and tax reforms are considered as critical aspects of the deepest global transformation taking place now, this does not mean that these problems are more important than others.

The way money works and the connection with land and tax laws in terms of the consequences for our society, however, are too often forgotten in studies on the changes in society, although these are the central aspects of the problem. Neither experts nor those who are studying alternatives to the existing social system seem to give the required significance to these crucial aspects of social and ecological problems.

Despite the fact that the monetary, land and tax reforms proposed in this book are only a small part of the changes necessary for the survival on our planet, they just fit into the framework of efforts undertaken to improve mutual understanding between man and nature and between people.

If we agree with the existence of social structures, which in their essence are directed against these goals, the social justice, ecological survival and public freedom are under threat.

The following idea seems very important to me: to combine social justice with as much freedom as possible, it is necessary to stop the speculation with all vital resources. These include not only money and land, but also energy, food, water and other basic resources. As we have already seen in case of land, money and tax laws, this is possible without infringing on the interests of free market and initiative of separate individuals and groups, which is the essential prerequisite for social development. On the contrary, only this will ensure social development in conditions of freedom for all. Speculators can continue their activities wherever it does not hurt anyone: postal stamps, antique furniture, glass, porcelain, works of art, etc. There is a sufficient number of areas of activity that, although important, are not vital.

Communist experiments to free a person from exploitation were not successful because personal freedom and free market were destroyed to ensure equality. On the other hand, too much attention to freedom in capitalistic society, jeopardizes social justice, ecological balance and basic needs of most people. Both systems, so to say, miss the target. In one of them the equality was above freedom, in another – freedom is higher than equality. And in both, there is some truth, but no one has been able yet to create the prerequisites for a truly worthy existence for people, although after recent events in communistic countries, it seems that capitalism has won.

The proposed reforms give all the advantages of free market economy without the shortcomings of modern capitalism. They combine the best aspects of capitalism and communism and point out "the third way" that will allow personal freedom and individual growth to be combined with free market and social justice at a much higher level.

The reforms will lead to the end of the exploitation of most people by the monetary system, which gives advantages to the minority, without introducing the inefficient planned economy or all-powerful democracy. They can create prerequisites for the emergence of ecologically oriented market economy in which goods and services will be produced in the optimal quantity and range.

If in highly developed countries the scale of wealth redistribution due to monetary and land laws is not so obvious due to the exploitation of developing countries, the latter pay in full for both illegal systems that colonial empires introduced and exploit them today more than the former colonialists. Although the population of developing countries suffers the most from this, the hope that the necessary changes in the monetary system will be implemented first in the countries of the third world is very little. The power there is in the hands of small political elite, which will unlikely leave the place in the sun, unless it is forced to do so with weapons.

Changes are more possible in small democratic European countries, and more recently in Eastern European countries freed from totalitarian communist dictatorships. The Scandinavian countries are relatively open to social changes, having a significant number of fairly wealthy and well-educated people. GDR, Poland, Hungary and Czechoslovakia are looking for new opportunities to unite free market economies with greater social justice.

During the public hearing of the UN World Commission on December 11, 1986 in Moscow, the representative of the Institute of State and Law of the USSR Academy of Sciences, A. S. Tymoshenko, said: “Today, we can no longer maintain the security of one state at the expense of another. Security can only be universal, but it cannot be limited only to political and military aspects, but must also cover ecological, economic and social aspects. It must finally make the dream of all mankind about the peace happen”.

The struggle of mankind for social and economic justice was long and persistent. There were sharp contradictions in political views and religious beliefs. Many people paid for it with their lives. We urgently need to learn to understand that no one can ensure his safety at the expense of others or the environment on which we all depend. For the practical implementation of this idea, we need to implement some deep changes in social conditions of our lives. The question remains whether we can reform our monetary system, land and tax laws before or just after the next major economic crisis or ecological catastrophe. In any case, it is useful to know how to create a means of exchange that serves everyone, and start replacing the revolution with evolution.

SILVIO GESELL.
"NATURAL ECONOMIC ORDER"

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Foreword

Under the economic order discussed in this book, we mean that it is natural in the sense that it is ideally “sharpened” for the nature of man. But this is not the order that spontaneously arises like the natural production of a product. This order, of course, does not exist, because the order that WE make by OURSELVES is only the act of our goodwill, the will that we consciously strive to bring to life.

The proof of the fact that the economic order is being arranged under the nature of man is the observation of the mankind development. The economic order in which humanity flourishes is the most natural economic order. And whether the economic order that stands this test is the best technically sound, whether it provides the best trade statistics – is a matter of secondary importance. At present, it is fairly easy to imagine that some high-tech economic system can come into contact with the gradual wear of human material. However, and this can be simply perceived as a matter of course, the economic order, in which humanity flourishes, must be technically perfect. For man, in the end, all this will happen only with the perfect work of man himself. **“Man is the measure of all things”**, including the economic system in which he lives.

The prosperity of humanity, i.e., of all and sundry, basically depends on how the selection of opportunities (which is selected from a certain number of possibilities) takes place under natural laws. The laws of selection require competitiveness. For only through competitiveness, mainly in the economic sphere the correct evolution, eugenesis take place. Those who wish to rely in their thoughts and actions on the alleged miraculous laws of natural selection, alas, must also base the economic order on competition, but the one that really flows in nature, i.e., with the use of that “weapon”, which the nature owns... **except for all privileges.** The success in competition must then be determined solely by innate characteristics, for only those are the reasons for success, “invested” in offspring and added to the general characteristics of mankind. **Children must inherit this success. But not through money, not through paper privileges, but through the ability, strength, love and wisdom of their parents.** Only as a result of this we can unequivocally assert that we have the hope that humanity, after some time, will shake off the burden of the innate traits given to us by the first humans and thousands of years of unnatural selection – **selection distorted by money and privileges.** And only in this way we can hope that excellence will leave the elect, and the mankind, led by its best sons, can continue its ascent to holy goals without interruptions and shocks.

But the economic order, which we are going to discuss, has another requirement to the natural order of things.

To flourish, human beings must be always able under any circumstances to behave themselves and act as natural for their human nature. A person must be someone, and not just pretend that he is this and that; he must go through life with his head held high and tell the truth, not being afraid to harm himself or fall into difficulty. Sincerity should not remain a privilege of fearless heroes. **The economic order must be so built into life** that a person can combine sincerity with the highest degree of economic success. **And dependence in economy should concern only things, and not people.**

If a person is free to do as natural for his nature, his religion, customs of his people and law to protect himself, then, from the economic point, his life MAKES him act differently: the person behaves like an egoist when he follows the impulse of self-preservation given to him by nature. If an evil deed conflicts with religious principles, and if a person, despite this, is morally prosperous, then his religious views should be strictly checked to see if the tree that produces good fruit is evil. We must avoid the fate of Christianity, where begging and complete disarmament in economic terms (before another economic force) are the only way out, simply by virtue of some kind of logical prerequisite; they say it is a sin to be greedy – for the result will be the only one: he and his offspring will go all **the way of natural selection**. Humanity will work in vain, if the best sons of humanity are sacrificed. Eugenic selection is exactly the opposite process. The best sons of mankind should be allowed to develop, because only by virtue of this we can hope that the inexhaustible riches inherent in man will be revealed in the best possible way.

Therefore, for an individual, the natural economic order should be based on his own interest. Economic life **painfully requires the will of man to commit such acts, which are in conflict with his innate laziness; in particular, requires strong impulses from the person, but, in fact, our egoism is the only impulse that has sufficient strength and constancy.** An economist who draws up a balance sheet, referring to the effect of pure egoism, calculates everything correctly. Therefore, Christian commandments should not be transferred to economic life, where pure hypocrisy will be the consequence of their application. Spiritual needs arise only after animal and material needs are satisfied, and **economic efforts are directed at satisfying animal and material needs only.** It would be absurd to begin work with a prayer or reading a poem. “Necessity is the mother of all practical crafts;

abundance is the mother of all arts", Schopenhauer said. In other words, we implore when we are hungry and pray when we are full.

Under "the natural economic order" we mean, consequently, such order in which people compete on equal footing, and with the help of the tools that they were provided by the nature, such order in which leadership falls into the hands of the most worthy and skillful for leadership, such order in which privileges are eliminated, where an individual, subjected to the impulse of healthy selfishness, goes straight to achieving his goal, not wasting oneself on doubts that are alien to the economic order, without overcoming them, because he has enough reason to think about them beyond the economic activity.

One of the conditions of natural order is fulfilled in our present economic life full of abuse. The current economy is based on selfishness, and its technical achievements, which no one denies, are guarantees of the new order efficiency. But another, the most important condition of ANY economic order that can be called natural – **the availability of equal opportunities in economic struggle – has to be still achieved.** A meaningful and constructive reform should be aimed at suppressing all privileges that can falsify the results of competition. This is the goal of two fundamental reforms, which are described further: **free land and free money.**

The natural economic order can also be called "Manchester system", or the economic order that was the ideal of freedom lovers – self-sustaining order, without influence from outside, the order in which the free play of economic forces cured mistakes of the state – as well as **socialism and its feature of poking the nose everywhere.**

Of course, one can say that **Manchester system** (F. Engels – emphasized by Yu. P.) is good for those, or rather for talking about it, whose experience has not been shaken by practical verification. Lack of practice is not a proof of the erroneousness of the plan in itself, and even the familiarization with what is known as “Manchester system” is enough for many to scold it: the whole theory, from the beginning to the end.

Manchester School of Economists chose the right doctrine, and further Darwinian inclusions were on point and in essence. But the first and most important condition of the system has not been fully investigated. For example, the answer to the following question was not answered: Where, in fact, is the field on which free economic forces can freely play? It was assumed, and sometimes for dishonorable reasons, that the conditions of competition in the existing order (including the existence of privileges attached to the right to own land and money) are already sufficiently free, provided that the state does not interfere in the game of economic agents and does not prevent economic agents from developing the economy.

But these economists have forgotten, or simply have not wanted to see, that for natural development the proletariat should be **given the right to “re-conquer” the land with the help of the same weapon with which the land was taken away from him.** Instead, Manchester economists appeal to the state (which has already sufficiently spoiled the free play of economic forces by its intervention) to establish the truly free play of these forces by coercive power. Such application of Manchester system was, without doubt, in full accordance with this theory. In order to protect certain privileges, dishonest politicians exploited the theory that ... **denies all privileges**.

To form the fair opinion on the unadulterated Manchester theory, one should start with a study of how it was applied. First of all, Manchester economists expected from the free play of forces that the usurious interest would gradually drop to zero. This expectation was based on the fact that in England, where the market is relatively well saturated with borrowed money, this interest was extremely insignificant in itself. The release of economic forces for their free play, with the increase in the loan offer as a result of "release", was to destroy the interest and thereby remove the plague spot from the existing economic system. Manchester economists did not realize that some of the defects of our monetary system inherent in it (which they simply accepted as they were, without verification) are insurmountable obstacles to their destruction, i.e., in this case, the privileges of money.

Again, Manchester theory assumed that the division of inheritance and natural economic superiority of children who grew up in abundance would share the land property and automatically give the rent to people, as a whole. This belief may seem naive to us today, but, at least, it was based on unshakable foundations; namely, that rents are tightly tied to the amount of protective measures (duties) after the introduction of free trade, but this became a dogma for the school itself. In addition to the foregoing, the workers of the railways and shipping companies received freedom of movement for the first time in their lives. This contributed to raising wages in England – at the expense of lower rent – to the level that emigrants earned with such difficulty (free farmers). At the same time, the products of free farmers reduced the price of products of English farms – again at the expense of English landowners. In Germany and France, this natural development was powerful also due to the introduction of the gold standard. By the way, this could lead to collapse if the state did not begin to oppose the first results of the gold standard introduction by other measures: introduction of duties on the wheat supply.

Therefore, it is easy to understand why Manchester economists who lived within the region of rapid economic development and thereby overestimating the importance of their theory believed that the free play of economic forces could, according to their expectations, also remove the second plague spot from our economic system, namely, the private ownership of land, i.e., the collection of rents due to this.

And, third, Manchester economists believed that as their theory began to work, and since free economic forces, at first, locally cleared "the territory" from the consequences of hunger, then the same methods, namely, the improvement of communication tools, organization of trade, development of banking services, etc. will also completely eliminate the systems from commercial crises. It has been proved that hunger is the result of defects in the organization of distribution of food stocks managed from the places, therefore, they said, commercial crises are the result of ineffective management of the distribution of goods. In this case, yes, if we know how much the short-sighted policy of the so-called protective duties affects the natural economic development of nations and, in general, the world, we can readily forgive the mistake of the free trade of Manchester school, i.e., the ignorance of mighty obstacles caused by the defects of traditional monetary system, and, in turn, to expect the disappearance of economic crises by the simple introduction of free trade.

Manchester school argues further: "If, under the universalism of the free trade principle, we can come across the situation in which the economic life will be full of life, if the result of such unhampered, uninterrupted work is the overproduction of capital, which in itself will reduce and then completely destroy the usurious interest, if, in addition to this, the effect of the free play of economic forces on rent is what we expect, then the taxpayers, in quantitative terms, will grow to such a level that within a short period of time all national and local debts of the world will be paid. This will remove the fourth and the last plague spot from our economic life, i.e., it **will save us from the state debt**. The ideal of freedom on which our system is based will be justified in front of the whole world, and our envious, spiteful, and often dishonest critics will just shut their mouths".

The thing that the honest hopes of Manchester school have never been fulfilled on any point, on the contrary, together with the irregularities of the existing economic order becoming larger and larger with time, is due to one fact, namely: Manchester economists, ignoring the monetary theory, perceived its traditional form without criticism, i.e., a system that simply destroys the very development that Manchester economists speak about and the development of which they predicted. They did not know that money makes usurious interest payment the condition for using money in services (of using them), that crises, budget deficits of those classes that earn with labor, and the resulting unemployment are, in simple terms, the most banal effects of the traditional circulation of money. Manchester ideals and gold standard cannot get along with each other.

In the natural economic order, free land and free money will wipe out unsightly, violating rules, dangerous interconnections of Manchester system from the planet and create the conditions necessary for a truly free play of economic forces. We will further see whether such social order is superior to the existing fashionable credo "today", which promises the rescue by diligence, sense of duty, lack of corruption and civic feelings in the overwhelming majority of all who are in power.

The choice lies between the private control and state control of economic life; there is simply no third option. Those who refuse such a choice can come up with some sort of order and call it with an attractive name, for example, “cooperation” or “guild of socialism”, or “nationalization”, in order to call for confidence in themselves. But you cannot hide the evidence, all this is one and the same, i.e., the vile rule of authorities, death of personal freedom, personal responsibility and independence.

Proposals expressed in this book will bring us to the crossroads. We will have a new choice; and we will have to either accept it or not accept it. So far, people have not been given such an opportunity – to make a choice and THIS choice – but the facts force us to act, because the economy cannot develop as it has developed up to now. We must either “repair” the malfunctions in the old economic system, or accept communism, i.e., common property. There is no other way.

It is extremely important for the choice to be made with utmost caution. There are no questions about the details, such as, for instance, whether the government will be autocratic or it will be a government of people, it is not worth arguing about what is more effective: work at a state enterprise or at a private enterprise. In our study, we will rise above these questions. **We are facing such problem – who and what will be handed the further evolution of the human race? Will nature, according to its implacable logic, continue with natural selection, or will the now weak human intellect (now degenerate!) surpass soulless forces of nature? This is what we must solve.**

In natural economic order, the selection will be carried out through personal achievements (with free competition of subjects and without any privileges to anyone!), and this, in turn, will lead to the development of **personal qualities**; since work is the only weapon of a civilized person in the struggle for existence. Man, through competition, is looking for himself in the world, taking advantage of the fact that he constantly increases and improves his achievements. Exactly what he has achieved (achieves) determines his ability to acquire a family, for example, how he will then raise his children, and how he will ensure the reproduction of himself and his qualities in them and through them. Competitiveness in this form cannot be compared with competition in sport (boxing, for example) or as a struggle for an unequivocal victory over someone else, or how the robbers behave. You cannot also bring it to the fact that the result of victory is someone's death. This type of selection is meaningless, since man's strength is not involved in his animal power. To understand how to achieve leadership through brute force, we will have to go deep into history. It was when the losers were losing everything, now those who lose in competition do not experience such sad consequences from life as before. The today's losers are simply experiencing more obstacles in their life path, because of their worse qualities, it is harder for them to acquire a family, it is difficult for them to raise their children, and, as a result, they have less offspring. But even this does not mean that this happens to everyone and is always the same, sometimes a chance plays its role. Nevertheless, **free competition spurs the most effective and leads to ever increasing reproduction; and this is fine in itself, because it does not allow humanity to stop developing, does not allow it to disappear.**

Natural selection, restored in its pristine purity, in future will be even more effective in natural economic order, if one gets rid of the privileges of sex. To ensure this, the land rent will be divided by the number of mothers in relation to how many children they have, this will be the compensation for caring for the upbringing of younger generation (for example, in Switzerland, mothers are paid monthly 60 francs per child per month). This will give women more independence, save them from the need to marry because of poverty, or tolerate marriage contrary to their feelings, or even slide down to prostitution after doing one or another false step. In natural economic order, women will not simply have freedom to choose their political representatives (worthless gift!), **but also the freedom to choose men for themselves; namely, the entire selective essence of nature is based on such free choice.**

The natural selection in its higher purpose will then work to the full. The greater the success of medicine in helping people to reproduce, survival of even the weakest, the more important will natural selection become, it will have to be encouraged and supported in every way. And then we can appeal without reproach to humanism, to Christian feelings and **to personally turn science to the needs of man. And then it will not matter how pathological the resulting material will be due to the reproduction of weak human individuals, the natural selection will do its job along with the efforts of man anyway. The art of doctors can delay the inevitable, but it is beyond the power of eliminating eugenesis.**

If, on the other hand, we decide that it is the state that should **regulate the economic life**, then we use nature in the selection process. The reproduction of people is not, of course, the fact that we formally hand to the state, but, to a certain extent, this influences the state very much. For only the state decides when approximately a person can acquire a family (and can he do it?!), and also what exactly and how will he provide his children (that means almost everything). Through the distribution of different salaries to its employees, the state is now very successfully butted into the process of reproduction of people (through its structures), and in future such intervention will be even greater. Soon, the type of people **who bow to the state** will prevail in human society. Then, the individuality will no longer be able to achieve something in his life, only through his own abilities, through relationships with others; on the contrary, **a person's relationship with the authorities will serve** as the measure of his success or failure. He will achieve success through **intrigues**, and the cleverest schemers will leave the largest offspring – of course, with innate thoughts driven by their ancestors and the qualities of their own kind. It is this kind of state control over economic life that will influence the selection of man, just as a change in fashion causes increased production of sheep with a certain density and color of wool, **the state will determine the number of white and black sheep in the herd.** The power, **in the person of the most intelligent intriguers selected as a result of selection,** will appoint – encourage or choke – EACH individual separately. Those who refuse, will become intriguers, will go aside, their type will diminish with time until it disappears at all. **People will be stamped under the state pattern. Development of samples of "non-pattern" type will be impossible.**

I will give the readers the description of social life that could have developed under the state control. But I should remind them that the principle of the free play of economic forces, even a caricature of it, known to us even before the World War I, let large sections of economy float freely. And that greater independence, which the money owners begin to possess, cannot be imagined! Try: people have COMPLETE freedom of choice of profession, work, exactly those that suit them, they live exactly as they want, they have complete freedom of movement and they do not know what state control over them is. No one asks them where they got the money from. People travel around the world without any baggage**, except for “Sesame open!” – a checkbook, which, nobody doubted, is the ideal state of things.** It is this state of affairs that is called the Golden Age – except for those who are excluded from free life because of defects in any other, even very strong, economic system – **apart from, in other words, the proletariat.** But are the shortcomings of the proletariat, the structural defects in our economic system, the reason why the system itself should be abolished, and instead to introduce a new system, the one that will deprive EVERYBODY of freedom, the one that will plunge the WHOLE world into slavery? Perhaps it would be more sensible to eliminate the structural defects, to grant freedom to the dissatisfied proletariat, and this is how to make everybody the participants and owners of priceless freedom of the current system? Because the goal is, of course, not to make everyone unhappy; on the contrary, to give EVERYBODY the access to joys of life, and this access can be open to all **only through the introduction of free play of the forces inherent in man.**

From the point of economic analysis, i.e., labor productivity, the question of what is preferable: a state enterprise or a private one is the absolute equivalent of another question, namely: Is the self-preservation impulse more effective in overcoming difficulties in life of each person than the impulse of preserving the human race in general? (**We mean the impulse that is more or less developed in each of us*: *preservation of the whole*, *species*, *society*, *people*, *race*, *humanity*).

This question, because of its inherent immediate practical importance, is probably more interesting **than the process of natural selection (which takes centuries).** Let us discuss it a bit.

There is a very curious phenomenon: the communist, the protector of social ownership of the means of production, usually believes that all other people – at least those whom he personally does not know – are, for some reason, more selfish than he. Therefore, the following often occurs: the most short-sighted egoists, who think primarily about themselves, and often only about themselves, are in theory true communists-enthusiasts. Everyone who wants to convince himself in this fact should declare at the communists' forum a purely communist proposal: to take everything away, bring it together and share everything equally. The result will be the oppressive silence of the meeting, even those, who were the most furious advocates of equality in equal distribution of material resources before the announcement of this proposal, will remain silent. Everyone will remain silent, because they will count in heads if they will receive equal amounts of material resources if they have equal salaries or not. Leaders sweep away such a proposal due to minor arguments. But, just think of it, there are no obstacles to introducing this principle in the communist community ... except for one – the egoism of communists themselves. Nothing prevents workers in the factory, in any community of people, in the trade union, to take and collect all the salaries together, and then to distribute them so that the needs of each individual family would be most fully covered by the monetary assistance. By putting this into practice, people will not have many difficulties; they will be able to convince the whole world that they do not only speak, but also do everything according to their communist principles, and also completely refute those skeptics who deny the fact that **a person is a communist in his soul.** Nobody forbids carrying out such communistic experiments: neither the state, nor the church, nor the capitalists. After all, neither capital nor paid employees are needed for such experiment, and **there is no need at all for long preparations and calculations.** You can start any day and at any level of the community. But the need among the communists in such community of economic life is so small that even no one thinks of carrying out such experiment (and did not even think). Contributing all salaries to a common "pot" in the capitalist system requires only that the results of labor must also be distributed in accordance with the needs of each individual; but the same community built with the help of the state or common property, also requires absolutely different thing: for each individual not to lose the desire for work and joy from it. By the way, communists can easily prove this in practice, having thrown all their salaries into a common "pot". To do this, after the general meeting decides to divide all the earned money equally (i.e., after the prohibition of all special rewards for specially exerted efforts!), the total effort (especially when working separately) should not decrease; for this, the common salary should not be less than previously received; and if the most productive communists gladly contribute their own salary to **the common fund (as they are doing now in the direction of their own pocket!)**, only then the entire scheme will be exhaustively proved. However, failures with countless attempts of communist experiments in the sphere of production show that **communism is impossible for one simple reason: the proposal to collect salaries in a common "pot" always bumps into empty emptiness – in any community any production of any goods requires special training, education, technical and**

commercial management, as well as the means of production themselves. Failures here, therefore, can be explained from different points of view, but this does not prove that the basic principle is wrong, that the spirit of communism, the sense of solidarity are too weak. Too much "common" puts an end to the debates about how much common should be enough. The refusal from the equal division is a direct testimony against the communist spirit, against the recognition that the impulse of race preservation is strong enough to overcome the pulling apart attempts to overcome the difficulties and tasks posed by life.

And it is not possible to get away from the inexorable logic of the above facts anywhere, **even considering the early communism of early Christians.** Let us just say that early Christians practiced the community of equal incomes, but not the community with a high level of production, more difficult to organize, acted on a spiritual, religious level; the subsequent communities that were doing the same at the family or tribal levels, were subordinated to the patriarchs, heads of families. In both cases, the process was violent resulting in fanatic subordination, and not impulse subordination. These communities were subject to the need to survive; they had no choice. And again, still there was no production of goods for exchange, division of labor, which makes individual achievements of each individual, it was not the right time. Primitive mankind ploughed and harvested crops, caught fish and hunted together, they all "harnessed" to the same "oxbow", and on such common impulse it was less noticeable who ploughed more and who less. And there were no standards, no measure of effort or success, **and they were not needed, life was hardly bearable because of the burdens.** But then the division of labor appeared, goods for exchange emerged, and the social order of primitive communism kicked the bucket. The exact amount of burden distributed among each member of the community became known to everyone, and this distribution became very quickly the relic of the past. Everyone began to strive to get rid of the results of his work, and most of all – the most hardworking workers, those who could indicate how to achieve high productivity, those who won this respect for their community. Leaders had to divide the community into levels, they had to support those whose achievements were the highest, above the average level. And when everything came to the point that the individual production emerged, the community of production disintegrated. The community of economic life, otherwise communism, did not disappear because it was feared of and it was constantly attacked by enemies. It surrendered to internal enemies, i.e., to those who demonstrated the highest efficiency. If communism, based on impulse, is stronger than selfishness, based on the impulse common to any person, then sooner or later communism will win. **The adherents of communism, no matter how they are beset with contradictions of complicated life, will always get together and will always unite.**

The driving force of communism, the impulse of preserving the race (sense of solidarity, altruism) is, of course, the diluted impulse of self-preservation, which individually manifests itself in economic life, and, thus, its effectiveness is in inverse proportion to the diluted amount. The larger is the community (commune), the less “solution” is saturated, i.e., the weaker is the impulse to work for the sake of preserving the community. An individual who works with one companion is less productive in his work than an individual who works alone and enjoys the results of his work alone. And if there are 10, 100 or 1000 companions, the impulse to work should be divided by 10, 100 or 1000; in the same way, if the whole human race has all the results of its work divided, each of this race can say to himself: “It does not matter how I work because my work is just a drop in the ocean”. The urge to work, in this case, is not an impulse; the urge replaces the simple violence.

For this reason, the Neuchatel scientist Charles Secretan, who said: “Egoism should, in principle, be an incentive to work. Therefore, everything that can give this impulse of egoism an ever greater strength and freedom of action should be encouraged; and everything that weakens and limits this impulse should be forgotten. This fundamental principle should be applied with invariance to everything, in spite of short-sighted philanthropy and admonition by churches” was right.

Therefore, we can be justified in that we promise that anyone who believes that he does not care about the high goals of natural economic order will still reap the benefits of the reform. From the reform, such people can expect the improvement in their food, shelter, better gardens. **The natural economic order will technically differ from the today's life, it will also differ from communism.**

GOVERNMENTS, POLITICIANS, BANK OWNERS AND ECONOMISTS

In most countries, the monopoly on the issue of money belongs to the central government. Therefore, an official test of a new monetary system, if it also comprises cash, should be approved and supported by the government.

Obviously, the attempt to introduce interest-free money is of great political importance. It requires the representatives of the ruling elite to recognize the fact that they have endured this highly unfair system for so long. On the other hand, it is really very difficult for most people to understand why it is better to pay for the money than to allow paying the interest. It’s just as difficult to understand as the fact that Sun does not turn round Earth, but Earth turns round Sun. We understand that this is so, but it is very difficult for us to imagine it.

At present, governments, politicians, banks and the economic system are declared responsible for most of the problems caused by the fundamental flaws in the monetary system. Their response: fight against consequences and half-way solutions, for example, partial exemption from debts, conversion of debts, temporary irrevocable loans in order to reduce social tension.

During the election campaigns there are regular promises to fight inflation, improve social institutions and support measures to improve the environmental situation. In the today’s monetary system, it is impossible to implement all this as a single set.

If the situation in highly developed countries seems difficult for us, then we cast our glance at the countries of the third world, which suffer most from the action of the modern monetary system. On the one hand, German and US banks are increasing their reserve funds, preparing for the financial bankruptcy of their debtors in developing countries, on the other hand, the industrialized countries are importing capital from developing countries, and not vice versa. New loans are provided to repay old loans, and this only prolongs and intensifies the international debt crisis. The need for an immediate change in this trend is unequivocally formulated in the report of the UN World Commission on Environment and Development under the heading “Our joint future”. It confirms the fact that the crisis phenomena in economy and ecology, with their apparent independence from each other, are, in fact, closely related.

Until the banks take into account long-term development prospects in their plans, they will not be interested in open discussion on how the interest system works. Now they are trying to veil the problem. Money should “grow”, “increase”, “multiply” – so the banks assure us. Even more often they try to fascinate people with the idea that money can “work” for them. But who ever saw the money work? Work is always performed by man, by himself or using machines.

Such advertising hides the fact that each mark or dollar, received by bank deposits, was first created by another person to later pass into the ownership of another one, who has more money than he needs. In other words: people who sell their labor force become the poorer, the more the incomes from the monetary capital increase. This is the whole secret of “working” money, and banks are very eager to prevent the consideration of the problem in this perspective.

The experience I have accumulated shows that those who have the appropriate knowledge to understand this problem and see the possibility of solving it, are afraid of these discussions, i.e., economists in many countries of the world who are afraid to get the label “radicals” (Latin radix). And they could try to turn to the actual roots of one of the most pressing problems of the world economy by supporting the idea of interest-free money. Instead, Gesell and his concept of “natural economic system” are considered in economic sciences only as one of many attempts of reforms that failed historically. However, some outstanding personalities of our century, for example, Albert Einstein, John Maynard Keynes and Ezra Pound, were able to see the value of Gesell proposals to reform the monetary system. Keynes expressed his opinion back in 1936 that “the future will learn more from Gesell than from Marx”. But this future has not yet begun. Although banking experts and economists should not be too far-sighted to understand that the payment for use within the new monetary system will allow them to solve the basic dilemma with which they have been fighting for decades. John L. King, a specialist in economic history, writes about the importance of the work of economists: “Crunching of numbers and computer formulas turned out to be just useless, and thus all economic forecasts became completely wrong”.

According to my observations, economists – unlike most engineers – do not understand the real explosiveness of exponential growth. It seems that they naively believe that more and more complicated economic models and calculations are capable of preventing danger.

Scientists who understand the danger, among them Batra and King, are mainly trying to give advice on how to escape from the consequences of the next big collapse. They do not offer alternatives to the modern system.

Those governments that are positive about the idea of reforming interest-free money in the near future will get on the path of social equality, environmental survival and recovery from monetary diseases that have been poisoned by the so-called “free market economies” for decades.

THE RICH

One of the most difficult questions asked by the people who understood the principle of the redistribution mechanism within the current monetary system is: Will those 10% of population that currently benefit from this mechanism and have levers of power in their hands allow the reform of the monetary system, after which they will no longer be able to receive income without any labor participation?

The historical answer: of course not. Until they are forced to this by those who have paid so far, they will not saw off the bough on which they are sitting. The answer in the new century can be like this: of course, yes – if those who benefit today, will understand that the bough on which they are sitting grows on a diseased tree, and there is a healthy alternative tree that is probably not going to rot. A sense of healthy self-preservation will make them change their tree. The latter answer means social evolution – the way of "soft" development, the first one – the social revolution, i.e., "the hard" way.

The way of evolutionary development will give the rich the opportunity to save their money, which up to this point they have made on the interest system. The revolutionary way of development will inevitably lead to sensitive losses. "The soft" way means that they will not be accused of obtaining the interest profit, since their actions will be considered legitimate until a new monetary system is introduced. "The hard" way, the way of revolution, can be very painful. The way of evolution means that there will be no more profits without labor, but money will be stable, prices will be low, taxes may decrease. The way of revolution means the growth of uncertainty, instability, inflation, prices and taxes that we see every day observing the development of events in the countries of the third world.

The experience I have accumulated communicating with people who belong to the categories of the last 10% shows that they do not understand the functioning mechanism of the interest system and do not know about the existence of practical alternative. With few exceptions, they would have chosen stability, not more money, since they basically have enough money to provide themselves and their heirs for generations to come.

There is a second question: What will happen if these people transfer their capital to other countries, where they can continue to receive interest instead of leaving it on their accounts, where they, although they will retain their value, will not bear interest?

Answer: soon after the reform introduction they will do just the opposite. Because there will be no difference in gain between what can be earned in other countries after the deduction of inflation and in your country due to the increased value of new money not subject to inflation.

The danger may lie in another thing, namely, that the country that has decided to carry out the reform will become "super Switzerland" with stable currency amidst the growing economic boom. Before, the capital depositors even paid for a while for the right to keep money in Swiss banks on interest-free bank accounts.

On the contrary, the policy of paying high interest rates, which was conducted in the United States at the beginning of Reagan's administration, caused such superfluous flow of money from all over the world that it would be possible to fulfill the obligations of foreign creditors only by means of increased inflation and drastic devaluation of money. With the interest rate of 15%, which was common occurrence at the beginning of high interest phase, in 5 years the United States would have to pay approximately twice as much as it received from foreign investors. At the present value of dollar, this would never have been possible. The further consequence of this policy was the transformation of the United States within 8 years into a country with the world's largest debt.

A huge amount of speculative money (estimated at about $500 billion) is circulating in the world from one financial center to another one in search of its profitable deposition. This shows that our problem is not the lack of money, but the absence of the possibility of implementing "reasonable" investment policy within the modern monetary system. The introduction of interest-free money in one region or one country would, e.g., demonstrate how quickly social and environmental projects can be implemented, which are now "out of bounds", and the result will be the emergence of a diseased and differentiated economy. Here, probably, excessive money will be placed from the country and from abroad, as instead of interest it is possible to get profit not affected by inflation. Therefore, it is much more profitable for rich people to support the timely implementation of the monetary reform that will lead to the system stability than to be exposed to the risk of inevitable collapse due to the growing instability of the modern system.

The third question concerns those who live at the expense of their capital, but are too old to work. What will happen to them in the event of interest abolition?

One can prove that those who can currently live off on their interest can live on their savings after the introduction of interest-free money.

Although neither the English queen nor such companies as Siemens, Daimler-Benz or General Motors officially have the functions of power, their monetary property actually has the authority of unofficial power. Scandals with payments by leading companies to political parties in Western Germany, the United States and other western countries show that all democracies are in danger if the mechanism described above for the money redistribution continues to operate freely.

Although we think that we live in democracy, with time it will turn out to be oligarchy – at best, and in the worst case – fascist regime, since money in the hands of ever fewer people cannot be controlled politically.

In Middle Ages, people believed that they lived poorly because they had to pay the tithe, i.e., a tenth of the income or goods to the feudal lord. Today more than a third of every dollar, mark or crown is in the pockets of capital holders.

And the fact that the economic situation of most people is better than in Middle Ages, due to the implementation of industrial revolution and increase in the level of automation of the economy. Only the understanding of the mechanism of redistribution within the monetary system makes it possible to understand why we still have to deal with economic difficulties.

Thus, the question arises whether we are finally ready to understand the dangers of social inequality that are caused by the action of the modern monetary system and change it, or we will wait for a worldwide ecological and economic catastrophe, the emergence of wars and revolutions. It is unlikely that individual or small groups will be able to change the monetary system themselves. Therefore, we should try to ensure the broad provision of information to the population and unite those who have the understanding of the essence of necessary changes with those who have the power to carry out political changes. It should be remembered, however,

- that no one can be accused of benefiting now from the interest system, since until now it is completely legal;

- which, on the contrary, should be stopped – the continuous constant acquisition of money without work;

- there should be no obstacles to where and how capital will be invested in future; if the capital holders are smart, they will invest in the country, which, with the cancellation of the interest system, will lead to the economic boom.

THE POOR

In 1986 each average German family's budget consisted of 90 thousand marks. That would be an excellent proof of our well-being, if it were distributed relatively evenly.

The bitter truth is that, as statistics shows, one half of the population has only 4% of all wealth, and the other – 96%. At the same time, the wealth of 10% of the population is continuously growing at the expense of all the others.

This, for instance, explains why families belonging to the lower middle class in Germany are increasingly forced to resort to the help of charitable institutions. Unemployment and poverty are increasing, although an extensive "social network" was established to overcome them.

The most important factor in the redistribution of wealth is the interest on money, which daily transfers 1100 million marks from those who work to those who own capital.

Although all social-orientated governments are trying to eliminate the resulting disequilibrium through taxation, this has not even led to a relative balance. The costs of maintaining a growing apparatus of social bureaucracy are expressed in the form of growing taxes. This rarely takes into account the loss of time and effort and humiliation suffered by people when they come across the bureaucratic machine.

The absurdity of the monetary system, which first deprives a person of his fair share in order to return some of this money to him in an extremely inefficient way through payments in the charity system, was almost never investigated by experts and was not the subject of public discussion. While those 80% of the population who are constantly paying for everything, do not understand how this happens, how can you expect changes?

There is no hope that developing countries will be able to handle the situation without major crisis or deep political upheaval. If the war means hunger, death, social and human poverty, then “the third world war” is already in full swing. This war was not officially declared. This is the war whose weapons are usurious interests, manipulation with prices, unfair terms of deals. This is the war that drives people into unemployment, sickness and crime. How long can we tolerate this?

In this regard, Werner Rosenberger says about “the corruption system” that closely links the corrupt rulers (Mobutu, Marcos, Noriega, Ceausescu, Honecker) in the countries of the third world and socialist countries, depositing their huge fortunes on secure foreign accounts, with owners of large capitals in all countries who receive millions on interest without any effort. Rosenberger writes: “The most terrible in this situation are, in my opinion, not corrupt rulers. They, as the recent history testifies, will sooner or later be toppled. It is really terrible that those who come to replace them, i.e., the new powers that be, talk a lot about reforms, but do not have suitable models for economic reforms”.

Without doubt, the number of those who suffer most from the current system is more than three-fourths of the total population of the earth. The situation in the countries of the third world could radically change if their debts were partially or completely written off by creditor countries and banks. This, as we know, is demanded by progressive representatives of church, economists and bankers, this is partially realized.

However, if the fundamental flaw in the money circulation system is not eliminated, a new crisis will inevitably arise.

Therefore, it is so important to spread the idea of new monetary system among those who need it most: in poor and developing countries.

CHURCH AND NEW SPIRITUAL GROUPS

Historical experience shows that religious leaders of different times, such as Moses, Aristotle, Jesus, Mohammed, Luther, Zwingli and Gandhi, tried to eliminate social injustice caused by constant collection of interest, and gave advice on that or announced a ban on receiving interest. They understood the essence of the problem.

So, in the book by Moses it is written: “If you lend money to your brother, poor fellow, never act with him as a usurer. You are not allowed to charge him the interest”. Aristotle wrote in his “Politics”: “The usurer is hated quite rightly, because the money with him became the source of income, and is not used for what it was invented. Because it emerged for the exchange of goods, and interest makes more money from money. Hence is its name (born). And those born are like the parent. But interest is the money from money, therefore, it is the most disgusting for the nature from all kinds of occupations”.

If we translate literally the text of the Greek original, then in the Gospel of Luke we read: “... and lend, not expecting anything”, and the Nicene Council, held in 325 A.D., forbade all clergymen to charge interest. The punishment of those breaking the prohibition was the immediate disfrocking. In 1139 the Second Lateran Council declared: “Who charges interest, shall be excommunicated and taken back after the strictest confession and with the utmost caution. Chargers of interest, who did not mend their way before the death, cannot be buried according to Christian customs".

Martin Luther (1483-1546) many times passionately denounced usurers: "And so the usurer and miser – is really not a man; he even sins in the inhuman way. He must be a werewolf, worse than all tyrants, murderers and robbers, almost as filthy as the devil himself. He sits not as an enemy, but as a friend and fellow citizen, under the protection and patronage of the community, but he is more disgusting than any enemy and murderer-arsonist. Therefore, if the street robbers, murderers and criminals are broken on the wheel and beheaded, how much more do you need to first break on the wheel and torture all usurers, expel, curse and behead all the misers ..."

The reformer Ulrich Zwingli (1484-1531) embarked on the course of secularization even further. On the one hand, he declared the interest as godless and anti-Christian, on the other hand, he recognized for the state to have the right to determine the interest rate.

Although they all knew the roots of the problem, but, however, they did not propose any practically acceptable solution for securing monetary circulation; thus, the fundamental flaw of the system remained untouched. The prohibitions imposed on the interest by Roman popes during the European Middle Ages, according to which the interest-taking Christians were excommunicated, shifted the entire burden of the problem to Jews who were allowed to take interest from people of other faiths. Since then, the latter have increasingly turned into the leading bankers of the world. Even from the Old Testament, the Jewish communities knew that interest destroys any social organism under the continuous action. Therefore, from ancient times, “Holy Year” was acknowledged – forgiveness of all interest and debts approximately every seven years. Thus, it was possible to limit the damage that was caused by interest, but it was not possible to find a lasting solution.

While the leading elite of Catholic Church in Latin America is oriented toward the capitalist model of the West, ordinary priests in the localities are more pro-communist. The system of interest-free money could give a historic chance for the solution that is neither capitalist nor communist, but much broader than both. It would provide justice more than any aid program. It would allow realizing stable economy and become the significant support for the church’s efforts to maintain peace throughout the world.

Today, the church is increasingly calling for donations to mitigate the redistribution process effects within the monetary system and the most acute problems that arise in both industrialized and developing countries. However, all this is only an attempt to cure manifestations of the disease, which does not affect the flaws of the money circulation system. Strictly speaking, the entire amount of donations collected by all aid organizations in industrialized countries is just one percent of the interest paid by developing countries to the rich West.

What is required at the moment, is the dissemination of information and open discussion about the effects of the existing monetary system and solution of the problem through the monetary reform.

The prohibition of interest is also applied in Muslim countries. It is not paid for loans there, but instead, the bank that provides the money, takes equity participation in the business, and later – in the profits received. In some cases, this is better, in others – worse than getting interest, but it does not change anything in the practice of generating income at the expense of others.

The spiritual knowledge, spreading in many countries of the world, indicates the profound changes taking place in the consciousness of increasing number of people. Their work on internal restructuring lays the foundation for external changes, while the peaceful transformation of the monetary system is the most important aspect of the problem. Therefore, great is the responsibility of all those who feel committed to humane goals, in a more accurate understanding of the practical opportunities in the conduct of monetary reform than it was before.

TRADE AND INDUSTRY

The prices of goods and services in the frameworks of the interest-free and non-inflationary economy would be regulated in the same way as now in current capitalist countries, by supply and demand. What would have changed was that the "free market" deformation caused by the action of interest would have disappeared. On average, each workplace in the industry of West Germany bears a debt burden of 70-80 thousand marks. This means that 23% of the average cost of labor is paid only for interest. Then the interest on the company's equity capital is added to the interest on the capital taken on credit. Both are oriented at the interest rate of the money market. Here, lies the reason for the fact that debts grow two to three times faster than the productivity of the country economy. The conditions are constantly deteriorating for those who want to establish a business, as well as for the working population.

At present, we see the concentration enhancement in all spheres of industry. Small businesses and industrial firms are repurchased by larger ones, and they, in turn, by even larger ones, and eventually in the so-called "free market economy" almost everyone works for multinational concerns. This development trend received an impetus from the idea of large-scale production, automation, as well as, since concerns had surpluses of money received at the money market. "Siemens" and "Daimler-Benz" in Germany earned, for example, more money at the money market than in the industrial sector. If small and medium-sized firms want to expand, then, as a rule, they should take out loans and be burdened with interest. They cannot make money either in batch production or at the money market.

Until now, our economy depends on capital. On this occasion a very fine remark was once made by the West German industrialist Schleyer: "Capital needs to be served!" The new monetary system, neutral money produce the situation in which the capital will serve the needs of the economy. If it tries to avoid losses, it will have to offer it itself. In other words, it will serve us!

AGRICULTURE

Due to the fact that the destructiveness of the interest system is most evident in the agricultural sector, the people working there can serve as an excellent information group for the new monetary reform.

Agriculture is a branch of production, which in the long term should be built in accordance with the requirements of the environment. Ecological processes develop in accordance with the curve of qualitative growth. At the same time, the industrial development must occur in accordance with the curve of exponential growth of interest and compound interest. But since in nature the growth cannot occur as the growth of capital, the increased exploitation of natural resources in agriculture is inevitable, which has become a threat to the survival of mankind.

At the first stage of industrialization of agriculture, peasants acquired ever more powerful machines. Owners of large farms then bought small homesteads and increased their lands. For these purposes, they received additional state subsidies and tax cuts, but they had to resort to loans, too. In order to pay them back, it is necessary to take everything possible from the soil, plants and animals. The consequences of such predatory exploitation are: drying of fertile soils, their hardening and compaction; pollution of water sources; disappearance of up to 50% of plant and animal species; overproduction of many products leading to an increase in subsidies on them from the state; rapid growth in the volume of cultivation of tasteless and poisonous hybrid crops, as well as complete dependence on imports of oil used for the production of fuel, fertilizers, insecticides, pesticides, etc.; destruction of tropical forests in order to obtain raw materials for the manufacture of packaging materials for longtime transportation between production, storage, processing, sale and consumption areas.

Although the interest is only one factor that affects these processes, the introduction of interest-free money can be of particular importance for the survival of important components of agriculture. Interest-free loans, combined with land and tax reform, which will make soil and water poisoning very expensive, would eventually allow the large-scale transition from highly industrialized agricultural production to biological cultivation of land. If research is carried out in the frameworks of creating new technologies for long-term agricultural production and cultivation of new crops, and this may lead to a new life style that allows rapprochement between city and countryside, work and leisure, physical and mental work, “high” and “low” technologies. Thus, it is possible to ensure the unified development of the individual, society and agriculture.

ECOLOGY OF OUR PLANET AND PEOPLE OF ART

If we measure our economic growth by the increase in the aggregate national product, we usually forget that this increase annually also falls on the ever larger volume.

On the other hand, constant economic growth leads to depletion of natural resources. **Therefore, in the frameworks of the modern monetary circulation system we have the choice only between the ecological and economic catastrophe.** At the same time, the concentration of money in the hands of fewer people and large multinational concerns will lead to the preservation of the need for heavy investments, for example, construction of nuclear power plants, super-large dams (e.g., in Brazil) and production of weapons.

From purely economic point of view, the long-term contradictory policy of the United States and European countries, which, on the one hand, accumulated a growing number of increasingly sophisticated weapons, and on the other hand, permitted the export of oil, grain and technology to Russia, was quite reasonable: the military production sector was the sphere where the saturation limit could be moved unrestrictedly as long as “the enemy” was able to produce weapons as quickly and in the same quantity. In addition, profits in the military sector were much higher than in any sector of the civilian industry. Understanding that the world war can no longer be won in modern conditions by any of the parties is gradually spreading now in the East and in the West. And the next condition for survival will be the ecologically appropriate use of the released funds. The penetration of banks and multinational concerns into the countries of the Eastern block after the revolutionary changes in the autumn-winter of 1989-1990 testifies, probably, that there was a chance to once again push back the fundamental solution of the social and ecological of the West at the expense of further economic expansion.

As a consequence of the new monetary system, the quantitative growth would very soon pass into the qualitative one. If people could choose between the simple accumulation of their new money with stable value or its investment in furniture, china, glass, art crafts or a solidly built house with stable value, they could probably often choose to decorate their daily lives. The greater the demand for durable goods and works of art, the more they are released. Thus, the attitude towards cultural values and art can change completely. Art and culture will become economically competitive, as it was at the time of the bracteate money in medieval Europe.

WOMEN AND CHILDREN

Why do women have such little influence in the world of money? The exchange and banks are the realm of men, and exceptions only confirm the rule. Many years of experience working with projects on women affairs allows me to argue that most women intuitively feel that something is wrong with the current monetary system. However, they do not know to the same extent as men what is wrong in it or what should be changed.

The years long struggle of women for equality and economic independence has awakened the feeling of indignation with such phenomena in them, which, like speculation with money, generate significant social injustice. Most women know from experience that someone should always work for what the other gets without difficulty. The majority of women belong to the half of the population that possesses only 4% of the total social wealth, whose work (housekeeping, raising children) is not paid for.

Since the beginning of the development of movement for free economy and publication of the book by Gesell "Natural Economic Order", there has been an idea that is as obvious as bringing money into compliance with the curves of natural growth, and that the earth, like air and water, belongs to all people. However, it is often shyly concealed or discarded as too far-reaching. It is the idea that the surplus value received from the use of land should belong to women and children who are the guarantors of that it will continue to exist. Helmut Kreutz calculated the value of the possible share in terms of per capita and came to the following conclusion: "If we sum up the two exempted values, namely, the increase in value and accrued interest on the value of land in the Federal Republic of Germany in the amount of 60 billion marks each, there is the amount of 120 billion marks for the payment of benefits to mothers or guardians to compensate for family expenses annually. The easiest way to distribute is by the number of children or teenagers. If the distribution takes into account all children under the age of 18 with the same amount of payment (in 1970, at the last census, they were about 13,6 million), there would be 8800 marks per child and 730 marks per month annually".

"Compensation of costs", paid not out of taxes, but, so to say, as the prepayment for the work done in upbringing children (the generation of people who create surplus value on land), will become the basis for the emancipation of women and children (men participating in upbringing children, of course, also enjoy the compensation of costs). There will be no freedom without the creation of an economic base. And yet: How far have we progressed in trying to turn domestic work and raising children into paid work? No matter how much, except for cases when a woman is recognized as a housekeeper, but only if she dies as a result of an accident, and the husband must receive compensation for losses.

Women and children around the world bear most of the burden in the form of economic and social chaos and social poverty arising from the current monetary system and land law. Neutral money, which in principle is “a technically advanced means of exchange” and benefit for children from the means of land rent can radically improve them. They know what exploitation is, so I expect women to be in the forefront of fair means of exchange. After the introduction of the new system, they are likely to deal with banking transactions and investment issues to a much greater extent, as they will work in the frameworks of a life-affirming and not destructive system.

Men prefer hierarchical structure of power, where the top is omnipotent, and the lower classes are powerless. Anyone who snatches a piece from the common pie leaves less for others. This is the situation with the winners on the one part and defeated – on the other.

Women picture the power as something possessing the possibility of infinite growth. When a woman brings power to a certain group, the whole group gets part of the increased power. This is the situation only with winners.

It is most important for women that their lives and lives of their children develop not along the revolutionary path that always condemns people to suffering, but along the calm path of evolution.

HISTORY LESSONS

The monetary system, inherited by us from our ancestors, has been more than 2000 years. The German word “money” (Geld) comes from the word “gold”. Gold is a metal quite unfit for anything else than a material for jewelry and crafts, became about 700 B.C. the preferred means of exchange in the Roman Empire. First, the money was equivalent to coins. This concept was included in the US Constitution. Gold or silver coins (or their deposited cover) before 1934 were the only legal means of payment in the United States. Until today, many people would like to return to the gold standard, since the surface perception creates the impression of greater reliability than almost unlimited printing of paper money.

Three quarters of the book by Silvio Gesell **“Natural Economic Order”** is devoted to the issue of the gold standard. The book was published in 1904. Unlike all recognized economists of his time, Gesell tried to prove theoretically and with many practical examples that the gold standard is not only useless, but even harmful for the well-functioning monetary system based on interest-free money.

Now we already know that the gold standard is not the necessary condition, and no single monetary system of the world is based now on the gold standard. In 1930, John Maynard Keynes, who knew the works of Gesell well, helped to eliminate the gold standard. However, he forgot to put forth another necessary component of the reform, namely, the replacement of interest with payment for circulation. In his book “Structure of Costs and Efficiency of Money under

Capitalism”, Dieter Suhr shows that Keynes did not think it through to the end, and also explains why this error, both in the past and now, raises the greatest problems.

The following historical examples allow me to reveal the complexity of the deep understanding of the problem of monetary circulation.

HOW CAN ANY OF US PARTICIPATE IN CHANGING THE MONETARY SYSTEM?

First, try to check how well you know the problems with family and friends. After that, you can have discussions with people you know less, do not hesitate to talk about it with your bank clerk, insurance agent, local politicians, journalists and press representatives. Numerous conversations with bank clerks and economists convinced me that there are no real difficulties, with the exception of spiritual barricades erected at the time of upbringing and limited understanding of the money functioning.

You must realize that money is one of the main problems of many people’s lives. They are most deeply connected with the idea of people about themselves and their attitude to the world around them. Generosity or stinginess, openness or isolation, warmth or coldness – all this is reflected in the attitude towards money. It is usually very difficult to treat money in isolation from other manifestations.

First, however, you should be able to explain how the income is redistributed at the expense of interest and that, even purely mathematically, the permanent collection of interest is impossible. Only after that you can talk about social and political consequences.

It is also necessary to understand that the problem of money is closely connected with a large number of other problems that cannot be solved automatically just by one reform. By itself, the monetary reform will not meet the needs of the poor, the elderly, the sick and other socially weak. The monetary reform will only facilitate the provision of assistance to these groups. This, however, does not mean that without special programs and significant efforts it is possible to solve social and environmental problems, as sometimes too enthusiastic and naive supporters of monetary reform argued in the past.

If you follow the development of world problems through the mass media, you will be more and more convinced of the need for immediate implementation of the changes and, at the same time, realize the responsibility that everyone, who knows this decision, is responsible for disseminating such knowledge.

SUPPORT FOR ATTEMPTS TO CREATE MODELS

One of the most important prerequisites for establishing the interest-free monetary system is also that it can be tested in real conditions, and in order to have an idea of the impact of such changes, the tests should be conducted on a fairly large scale.

It is desirable that regions or countries interested in holding such actions should agree on joint security arrangements with the availability of various social, cultural and economic conditions. The regions, in which the experiment needs to be conducted, should be of sufficient size to give convincing results for the whole country on their example. In addition, the significant level of self-sufficiency is desirable, so that the significant amount of goods and services needed for the exchange of goods and services is available to trade and industry.

On the other hand, it is possible to conduct the experiment in the region with underdeveloped structure of the economy, where neutral money could be an incentive for establishing the more diversified and stable economy. Probably the latter case is even more attractive, since people with a worse status are more open to changes, especially if there is a chance, as was the case with the city of Wörgl, to win and nothing to lose. To obtain reliable results, it would be useful not to limit the experiments by this or that situation. All the diversity of results can give the picture of what the introduction of interest-free money gives in various social conditions.

INTRODUCTION OF LOCAL OR REGIONAL MEANS OF EXCHANGE

Of all the experiments on the exchange of goods and services with the help of interest-free money, the best known is the one conducted by Michael Linton on the island of Vancouver in Canada. The exchange system, called LETS (local labor and trade system), operates with units of exchange oriented at ordinary dollars, the so-called "green dollars". Trading partners agree on the price of goods and services received from each other in green or conventional dollars, sometimes in both, and after each transaction, their debits or credits are transferred into the centralized computer account management service. First, the maximum debt level is set for everyone, which can later be changed in order to minimize the risk for both parties to the transaction. It is clear that the system becomes the more profitable, the more parties participate in it. In 1987, Canada had about ten LETS systems, and 10 more – in other countries of the world.

The problem with this system is that people who have made too large fortune are not interested in transferring to those who probably need more than they can borrow, this “reliability of exchange”. This means that without collecting payment for circulation, there is a tendency to stagnate.

In Switzerland, since the 30s, the exchange ring, called WIR, with the turnover of 1,5 billion Swiss francs has been operating nationwide. This is one of the few successful attempts of the interest-free exchange of goods and services that has been implemented. The ring works, like everything else, with the help of the centralized account management service, within which the centralized control and accounting of debits and credits are carried out. Numerous similar exchange rings operate on commercial basis in the US.

In Denmark, since the 30s and in Sweden since the 60s, there has been the system of banks of the LLC (Land, Labor, Capital) (in Sweden this bank is called JAK). They offer interest-free loans after a certain period of saving without interest. Since not everyone needs loans at the same time, but everyone needs to accumulate a certain interest rate for obtaining a loan, the system offers the opportunity to coordinate the customer savings and needs for loans in such a way that all participants benefit from the interest-free system.

Various attempts to introduce alternative money are politically expedient for better understanding of the money functioning system and the purposes to which they should serve. The practical experience is important because it inspires courage to carry out reforms in the required larger scale. However, none of these small experiments changes anything in those global world problems that arose from the actions of the current monetary system. Therefore, one should not lose sight of our goal – achievement of changes in monetary circulation at the national and international levels.

ENCOURAGING CAPITAL INVESTMENTS OF ETHICAL NATURE

Everyone should try to invest extra money in projects of ethical character. This is an urgent task. An increasing number of people have realized the social and moral impact of capital investments of ethical nature. In the US, these investments amounted to several billion dollars. According to Hazel Henderson, "an increasing number of ordinary people smelled the decay of the rotten system at the threshold of their home, and could no longer allow their money to act directly against what they wanted for themselves in life".

People who make investments of ethical nature, choose the possibility of investing in accordance with the requirements of the economy and social policy. Companies such as Robert Schwartz (New York), one of the pioneers of socially acceptable investments, first of all deleted companies of military-industrial complex from the list of their potential investments, and then those companies that did not provide their workers and employees with normal working conditions or were obvious environmental polluters. They invested capital neither in the operation of nuclear power plants, nor in those firms that cooperated with repressive regimes, for example, South African.

The ecological thinking is not only vitally important, but also expedient from an economic point of view, especially as a result of the continuing thoughtless wasting of resources, which causes an increasing depletion of reserves. So, it turned out that the nuclear industry, absorbing billions, designed to eliminate consequences of accidents and pollution of territories, is already extremely unprofitable for US investors today. Capital investments in the field of alternative energy sources, on the contrary, are becoming more profitable.

Capital investments of ethical nature can be carried out now, regardless of whether the monetary reform will be implemented sooner or later. Investments of ethical nature are good for any monetary system.

ABOUT THE AUTHOR

What made an architect, specialist in urban planning and environmentalist with doctoral degree in public and international problems write the book about money?

In order to answer this question, I have to return to the period of 1979-1984, when I was the Head of Research Section on Ecology and Energy in the frameworks of the International Building Exhibition (IBA) in West Berlin, held in 1987. Due to the exhibition, we were able for the first time to plan and implement large-scale environmental projects in urban environment. These works aroused great interest in the country and abroad, on many of them the reports were made to the public and specialists, but they also caused constant skepticism. Most often the following argument was used: "All this is very beautiful and important, but it is uneconomical or cannot be paid for". From that moment, the possibility of applying our ideas in practice acquired not only professional interest, but also became the matter of survival for me.

Already in 1979-1980, for us, who had the necessary information, became clear that the biological bases of life in the city: air, water, soil, energy, food – are facing the utmost danger. This meant that if, from an economic point of view, we will not be able to improve and preserve them, then we will destroy ourselves after a certain period of time.

The question of the economy, however, became more and more decisive. I found a lot of people in the world who had goodwill and good ideas. All ecological problems were technically resolved, but the economic and political prerequisites for using them on broad basis, i.e., simply the money, were and are still lacking. I understood that the struggle for money to carry out ecological activities and projects would be the struggle on several fronts: first, we were at the stage of introduction and transition, which always involve increased costs. Second, long-term economic prospects were still not the basis for financial instructions or constructional regulations or the choice of building materials and technologies. Third, air, water and soil were still contaminated almost for free, although new legislative grounds for their protection or taxation were already in operation.

However, one of the battle fronts, probably the most important, remained hidden for me until 1983, namely: the money-making power of money or the fact that any ecological event should be measured by the interest that can be obtained for own money in the capital market. After I also realized the different patterns of growth in nature and money circulation and causes of pathological forced economic growth, I was seized with rage. **I realized that I had lived 40 years of my life without understanding the basic prerequisite of my everyday existence: the function of money** (Emphasized by Yu. P.). I began to read more on this issue, discuss it, and then write, because I almost always came across the same misunderstanding with friends, acquaintances, colleagues and specialists. The fear that we, or at the very latest our children, will witness the most terrible economic or ecological catastrophe in modern history, did not leave me. **Until today, I cannot understand why economists will not have the courage to tell us the truth about our monetary system** (emphasized by Yu. P.).

It took four years before I realized that the money considered in this aspect, as in this book, is more of “a public and international problem” than a purely economic one. Since I defended my thesis in this field of knowledge, I started working on a book on economics, although I myself am not an economist. The book is devoted to the main unit of measurement of the class of economists – money. My goal was to make an introduction to this problem that would be interesting and easily understandable, would prompt as many people as possible to learn more about the hidden causes, problems and opportunities for change. And this book appeared.

Dr. Margaret Kennedy was born in Chemnitz in 1939; in 1959 she graduated from high school in Kassel; she studied architecture, graduated from the higher technical school in Darmstadt in 1966 as a certified engineer; she worked as an architect, a specialist in urban planning and ecology in Germany, Nigeria, Scotland and the USA; in 1972 she got her master degree in urban and regional planning, and in 1979 – PhD in public and international problems, both theses were defended in Pittsburgh University, USA; since 1972 she has been implementing research projects on the construction of school buildings for the Institute of Countries (Berlin), Organization for Economic Cooperation and Development and UNESCO in 15 countries in Europe, North and South America; in 1979-1984 she was the Head of Research Section on Ecology and Energy in the frameworks of the International Building Exhibition; in 1984-1985 she was a visiting professor of urban ecology at Universities of Kassel; since 1985 she has been working on planning and implementation of the model project “Permaculture” in Steigerberg and restructuring of the village around the factory for the production of ammunition of the Third Reich for the spiritual and ecological commune. Numerous publications, lectures and seminars on the themes: schools as centers of social life, women and architecture, urban ecology, permaculture, ecology and economics, including "Eco-city", vol. 1 and 2, published by Fisher-Alternative, 1984.

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Qualimetry (*quality measurement*) *in the system “Lean manufacturing”*

It is natural to believe that the state system of public administration does not leave every citizen of the country indifferent in the proposed system of patriotism (true or “quasi”). Here the need for clarification arises. Patriotism (Ancient Greek: πατριώτης – fellow countryman, compatriot”):

1) a person who loves his native land, devoted to his people, ready for sacrifices in the name of the interests of his or her native land, somehow understood;

2) a person tied to the place of his birth or residence;

3) a person who is deeply committed, tied to his deeds. The demonstrative patriotism is called “jingoism”; the extreme form of patriotism is nationalism [Dictionary of foreign words. 2006].

The expression of patriotism for every citizen is his creative activity – the result of labor, contributing (conforming) to state regulations (legal laws).

One of the normative legal documents that form certain certainty for the scientific perspective is the Federal Law dated June 28, 2014 No. 172 – FL “On Strategic Planning in the Russian Federation”. The law envisages the processes of targeting, forecasting, planning and programming of the social and economic development of the Russian Federation (Article 1.3 of the Federal Law).

One of the main concepts is “4) goal-setting – defining the directions, goals and priorities of social and economic development and ensuring national security of the Russian Federation”. From this concept it is necessary to comprehend the constituent parts: the development goal, the goal direction, the priorities of directions.

"The development goal. The subject on which it is supposed (to be called, obligated) to influence and develop "spiritual maturity, enlightenment and culture" through the economy (Ancient Greek οἶκος – property management) is 1) thrift, efficient expenditure of means, labor, ideas, etc." [Dictionary of foreign words, 2006]. To clarify the essence of the word "goal", included in the strategic goal-setting in public understanding, it is necessary to address to the explanations of single, group, geographic-spatial, philosophical, managerial, legal meanings. Since the goal is related to strategy, it becomes necessary to understand from general philosophical explanations. Philosophers of the 70s of XX century taught us: "The goal is the ideal anticipation of result in the mind, for the achievement of which the action is directed. The goal expresses the regularity of human cognitive activity, his dependence on the surrounding world, on objective laws with which the conscious activity of people must be agreed. The goal **being in conflict** with these laws, eventually **collapses** (emphasized by Yu. P.) ... Individual, similar and immediate, public and private, intermediate and final goals are distinguished. The great ultimate goal of Soviet people – communism – has now become the closest immediate goal" [Philosophical dictionary, 1963].

Has the goal of peoples of the Russian Federation, called the Great, disappeared, been completed, terminated, acting, etc.? It is not mentioned in the state strategic document. However, there is the Communist Party in the Russian Federation and it is represented by its strategic goal in the State Duma, the People's Republic of China links its development goals with the strategy of communism, the communist and socialist parties have not disappeared in the world system. Consequently, the concept of the development goal had the contradictory interpretation in the past, and now in the new XXI century philosophers "shamefully" bypass the field of reasoning about the ideas of social development, modern trends and ways of strategic development. The Dictionary of philosophical terms can be the evidence of this [Dictionary of philosophical terms. Moscow: INFRA-M, 2004. 731 pp.]. It is issued for the 250th anniversary of Lomonosov Moscow State University. It does not contain the term "strategy", the goal is set forth irrespective of what was stated by the colleagues in the Soviet period, the development is philosophically interpreted: "Development is an essential, necessary movement, change of something in time. Movement as the way of matter existence does not arise and does not disappear, but eternally exists, has no beginning, no end". Identifying development with movement, the authors of the dictionary completely **bypass** the development of socio-economic phenomena and processes.

The age-old stage of development of the Soviet Union is bypassed by the philosophers of the main University of the Russian Federation, and the communism is interpreted as follows: "theory of social order based on the priority of public ownership and principle of equal distribution of wealth ... The term "K" was used to define the political **regime** (emphasized by Yu. P.) in the USSR, China, the countries of Eastern Europe". Socialism as a system of socio-economic life of people and socio-political governance of the state is not included in the subject heading list of the dictionary. "Capitalism is the means of production and type of society", the authors of the dictionary state this term on five pages with the primary emphasis on the factors that positively characterize it from the position of local and comprehensive management (control). For our study, some of the conclusions of the authors-philosophers of MSU are notable for the fact that “a capitalist in **order to survive** (emphasized by Yu. P.), has to continuously maintain the most accurate calculation. Before starting the production of a product, he must **estimate** (emphasized by Yu. P.) how much the production of this product will cost, find out whether the product **will sale** (emphasized by Yu. P.), how many **competitors** (emphasized by Yu. P.) he will have, what will be with **market conditions** (emphasized by Yu. P.) by **the time** (emphasized by Yu. P.) when his product is put on the market ... As a seller, he tries to sell at the highest possible price, as a buyer – to buy as cheaply as possible, but, at the same time, of the best quality possible. The need for it is the most accurate **calculation** (emphasized by Yu. P.), and so on and so forth” [Dictionary of philosophical terms].

Is it possible to provide for the selected desires and necessary actions of a capitalist and the aggregates of their individuals (without considering the activities of multinational corporations – MNCs) under the conditions stipulated in the Federal Law No 173 “On Strategic Planning in the Russian Federation”? A capitalist is not indicated among the participants in strategic planning, the capitalists-citizens are not invited.

But what to do: The capitalist (in the past, present and future) has personal and involuntarily-corporate strategy: goal-setting, forecasting, plans, target programs. He certainly wants to participate in monitoring and controlling the implementation of his development goals, he needs to join the general strategic movement, he longs for being included in the system of documents that determine his legal status as a necessary patriot of his country. However, the sense of independence, disgust for someone else's glance in his "pocket" does not leave him for a single moment but, but ... the capitalist has to:

-survive and survive for a long time (50-60 years) and even as family-clan (hundreds of years); historically, geographically, territorially – forever;

-continuously keep the most accurate records: to whom, when, how much, etc.; from whom, for what, how much, etc.; he needs book-keeping, accounting, and, moreover, one method – for himself, another one – to save the secret (commercial); deep inside the capitalist has the secret dream – to have his own bank, his police and even his municipality;

-estimate the sale of his goods and closely monitor the competitors; build up and have the system for monitoring the competitive environment, have his own intelligence in the form of marketing and sneaky marketeers;

-buy the goods at a low price (strategically for future use (stock)) having **the potential** (predicted based on the engineering and qualimetric parameterization) higher quality indexes;

-sell the goods so that the promotional qualities of this product (services) make the buyer of this product fall into euphoria (Ancient Greek εὐφορία – light, fruitful, well-carrying, joyous, overflowing feeling of lightness and happiness), for which the consumer is ready to pay (it is the best for the seller – with the world-wide recognized notes);

-the most accurate calculation of the ratio of quality to cost is the immutable law of the capitalist, but it acts only for him, for the others – the laws of unknown but implicit market that is not determined by the strategic settings of the state.

These and other characteristics of the capitalist and capitalism system are widely known, and various types and behavior of the capitalist manager are set forth in hundreds and thousands of publications (studies, stories, novels, and even tales and sayings). But the essence for the Russian citizens is in something else. Why did not the Main Philosophical School of the Russian Federation (Lomonosov Moscow State University) consider it necessary to define its understanding of the following terms in the Dictionary of philosophical terms: socialism, planning, forecasting, programming, quality, qualimetry? Even for the term "thrift" the philosophers (2004) give the following example: "In Franklin's Code "thrift" is one of the virtues of the bourgeois, its normative requirement: Spend money only on what benefits others or yourself, i.e., do not be wasteful". The main Russian philosopher in Soviet Russia did not find any imitative examples for explaining "thrift", which is the concept reflecting the actions of the universal law in practical life: "Achieving maximum results at the lowest cost", which is valid for both "them" and "us". But the philosophers of MSU did not try to find this law in "the thrift" of everyday life and managerial activity. It was important and timely for them to show "themselves modern" by the time and place of the destruction period.

But French practitioners Yves Bernard and Jean-Claude Collie investigate and bring in their "Explanatory Dictionary" the following terms: quality, plans, forecast and the corresponding philosophical categories: socialism, capitalism, communism, explaining and comparing the positive and negative aspects of social structures .

The scientific environment of the world community and, above all, Russian scientists will have to find the answer to the question: "Why was not the socialism successful in the USSR?" And return again to the "Principles of Communism" from the standpoint of "Divine Justice".

Real life in the Russian Federation is more and more inclined to the paradigm: public-private entrepreneurship (partnership) in publications is often called: private-public partnership. Simplified and formally it seems nothing special, but it is essential for public administration – two identical words, but given in the order of importance result in the opposition of mutually destructive character.

The priority objectively belongs to the state power, the legislative and regulatory legal requirements of social life adopted in the form of legal laws, standards, managerial methods and public control acquire the prevailing and primary importance.

The favorable environment for further development of management under the scheme "public-private entrepreneurship" is created by the complex of national standards of the Russian Federation "Lean Manufacturing" GOST 56020-2014. The standard establishes: "3.2 Philosophy, values and principles of lean manufacturing (LM)". Let us give some basic concepts.

3.2.1. Philosophy of lean manufacturing (LM). The philosophy of LM is based on representing business as the flow of value creation for the consumer, flexibility, identifying and reducing losses, constantly improving all activities at all company levels, involving and developing staff to raise the satisfaction of consumers and other interested parties.

3.2.2. Values of lean manufacturing (LM). It is necessary to distinguish the value from the consumer's point, expressed in terms of **usefulness** (emphasized by Yu. P.) and **organizational values** (emphasized by Yu. P.), established and formulated for the organization, its owners, managers and employees. The main organizational values of LM are: a) security; b) value for the consumer (including the quality of products, processes, systems); c) customer orientation (including flexibility, adaptability); d) reduction of losses; e) time; f) respect for the person. Ideals, norms, prohibitions and taboos, clearly formulated following the company spirit and Charter can also serve as values.

The same provisions and formulations can reflect both the values and principles adopted in the organization. The main difference between values and principles is in their focus. Values are what should be separated and used for **self-management** and **self-organization** purposes (emphasized by Yu. P.), i.e., the basis of self-organization of workers. Principles are what define the approaches to **the construction of the system** (emphasized by Yu. P.) of management or organizational structures of management.

3.2.3. Principles of lean manufacturing (LM): a) strategic focus; b) focus on creating value for the consumer; c) organization of the flow of value creation for the consumer; d) constant improvement; e) drawing out; f) reduction of losses; g) visualization and transparency; h) priority security provision; i) building up the corporate culture based on respect of an individual; j) built-in quality; k) making decisions based on facts; l) establishment of long-term relationships with suppliers; m) compliance with standards.

3.3.1. Goal-setting in LM concept shifts the emphasis from short-term goals to long-term ones to increase the business sustainability. For this purpose, special attention should be given not only to the results, but also to the increase in the capabilities of the processes, improvement of their characteristics (productivity, speed, efficiency of the use of all types of resources).

3.3.2. LM concept covers all levels of the value creation chain, starting with the interaction of companies in the supply chain and ending with the level of specific operations (1 – intercompany level, 2 – company level, 3 – level of processes, 4 – level of operations).

The creation of LM concept in the form of a set of National Standards is a breakthrough of the ideas, principles, methods and practical actions of the Soviet system of "scientific organization of labor, production and management" into the modern global institutional environment, once (beginning of XX century) initiated by Taylor, Ford, Fayol and their associates in the USA, France, Germany. Thanks to strategically active specialists from Japan, our not very successful experience can become a reality in the search for lost "paths" and "roads" of the country's governance. But in this search, there are methodological problems of understanding and realization of LM concept.

We note some generally significant problems. The global interconnection between countries and continents is governed by regulations adopted by the United Nations (UN). One of them is the international system of accounting, in which the primary subject of economic activity is designated by the term "institutional unit". If we take into account the standardly stated principles, the concepts that cover all "levels of the value creation chain", then LM concept becomes limited to only one part of the institutional environment – manufacturing. Institutional units analytically and statistically cover all "value chains" in the accounting system: the origin of ideas, their distribution and legitimization, the whole chain of inheritance and design, homogeneous production units, business units and consumer units.

LM standard establishes the philosophy, values and principles of lean manufacturing (section 3.2). However, for the quantitative methods that accompany the institutional system (instructions, organizational forms of institutions), the general principle is needed that will allow the quantitative characteristics to be combined in relationship from single, homogeneous, sectorial, industry-specific to the nationwide state generalization. This principle (Latin principium – basic starting point of any theory, doctrine, science, world outlook, political organization) seems to be strategically understood: "achievement of maximum results at the lowest costs – this is the immutable law of management".

There is the need to call it a conceptual principle, i.e., the main idea, the leading idea, the constructive principle of various types of activity, united by the single quantitative characteristic. The indexes of the conceptual principle are: result – R; expenses-costs – E; benefit – U. Then

$$U = \frac{R \to \max}{E \to \min} \; .$$

If $t = t_0 + \Delta t$; $R = R_0 + \Delta R$; $E = E_0 - \Delta E$; $U = U_0 + \Delta U$; ΔR – increase, growth of quantified expression of the result of the institutional unit (organization); ΔE – decrease, quantified expression of reduction of the resource expenses of the institutional unit (organization); Δt – fixed time interval of the institutional unit (organization) activity; ΔU – benefit gain obtained for consumption in the institutional unit (individual, family, household, organization, institution, etc.).

The conceptual principle of the benefit is comprehensive in socio-economic hierarchy and in the interconnected chain of lean manufacturing. The structural interrelation of production of benefit consumption can be depicted through the components of the national economy.

In analytical expression by the mathematical function of the benefit conceptual principle the two concepts are applicable: expenses and costs, by connecting them with the equivalence (uniqueness) sign, it is necessary to clarify the meaning of important terms for LM system.

The authors of economic and mathematical dictionaries and reference-books proceed from the general economic terms and, concerning the calculation methods, they tend to generalize through the concept of expenses. The author of Brief economic-mathematical dictionary (1979) L.I. Lopatnikov explained: “Expenses are the widely spread concepts in economic literature, however, not having universally accepted definition. In its most general form they are resources “demolished” in the production process (understood in the broad sense including, for example, storage, transportation, etc.) to obtain the products of this production. Then, if we consider manufacturing as a cybernetic system, the costs are inputs and the results (products, effect) – outputs: the production process, accordingly, acts as the conversion of resource expenditures into the results”.

Here L. I. Lopatnikov distinguishes the independent term: “input-output – name of the cross-sectorial research method of production and product distribution, introduced by the American scientist W. Leontief. He suggested that in the early 30s of XX century the model “input-output” was very similar in structure to the first balance sheet of the Soviet economy in 1923-1924. He also used the idea of “technological coefficients” that are independent of the volume of output. “It is regrettable that in the future development of planning “technological coefficients” of economic and political system of the USSR were not accepted. The technological coefficients of W. Leontief were essentially the prototype of “qualimetric indexes” of designing-technological rationality of product manufacturing, i.e., qualimetric indexes in lean manufacturing.

It appears that for the theory and practice of lean manufacturing, if judging by “the basic law of economic management”, it is preferable to use the word **expenses** in the English translation designated in mathematical formulas with letter “E”. To interpret the essence of LM as a set of standards such univocal understanding and identification is required for methodological unity in theory and practice.

There is the need for clarifying analysis of the term “maximum results”. First of all, “the result (Latin resultatus – reflected) 1) result; what is obtained at the end of any activity; 2) index of skill”. In relation to economic and mathematical research, L.I. Lopatnikov recommends: “The result (outcome) in operations research, play theory, decision theory is the same outcome, consequence of the implementation of decision, acceptance of alternatives, selection, effect of factors”. With regard to economic activity: “Result (benefits, gains) – is a general term encompassing the variety of economic and non-economic effects of functioning of economic systems. In literature there are three interpretations of this term.

1. Anyway, the measured or evaluated **volume of products** (in the broad sense, i.e., the output, comprising, e.g., tangible and intangible services, wastes polluting the environment, etc.) produced during the system operation; therefore, the result is the system output, the effect of its operation to the external environment. In this case, to measure the result means to give **the external evaluation of the system functioning.**

2. The difference between the useful part of the system output – its product and cost of resources for its production. The results characterizing the gain of the system itself are

considered here: first of all, the accumulation or reduction (exhaustion) of its resources ... **The internal evaluation of the system functioning** is obtained.

3. The most common political and economic significance of the term "results of economic activity" is the satisfaction of social needs in certain **benefits**, i.e., the increase in the aggregate of social utility.

Developing reliable methods of comparing the costs and benefits is one of the specific problems of economic science and economic-mathematical methods, in particular".

To reflect the useful properties of the product, the unified commonly recognized methods of quality analysis are required, the quantitative indexes of the product utility are necessary, i.e., the product, as the result of activities, must be calculated quantitatively. The problem of quality measurement, despite its antiquity, has not yet found its solution. Here, the mystery of measuring the benefit of actions in the system of lean manufacturing, declared as an axiom, is hidden (Ancient Greek ἀξίωμα – starting, initial position of scientific theory).

The thesis "values" is forcing researchers and followers of LM delve into the semantic content of the term "axiology (Ancient Greek ἀξία – value, dignity + ... logy Ancient Greek λόγος – word, teaching) – the teaching of values, i.e., of positive or negative significance of the objects of the surrounding world for a human, social group or society, in whole". In ordinary everyday meaning, the vast majority of people quantitatively identify (equate) the value (utility) with price expressed in monetary units. Such common understanding **is detrimental** for philosophy and practical development of lean manufacturing as the conceptual trend in the Russian Federation. And that is why.

It is generally accepted that: “Price is the monetary expression of the value of goods; the economic category required for indirect measurement of the magnitude of socially necessary working time required (or already spent) for the production and output of this product; the quantitative relationship between the set values of supply and demand at the consumer market” [Great economic encyclopedia, 2007; Azriliyan A. N. Great dictionary of economics, 1999]. Azriliyan A. N. gives over 200 varieties of prices by their allocation and application. Great economic encyclopedia – over 70 varieties. What meaning of price is acceptable for use in LM remains quite uncertain. Therefore, it is essential to determine, in the basic understanding of the value and price, their cardinal definition and expression (as in mathematics), the cardinal number.

Let us refer to LM philosophy, now typically expressed through the concept of value. From the philosophical point, the value is the subject studied by axiology (science, founded by Aristotle in III century B.C.). Value is what people’s feelings make to recognize as being above everything and what you can strive for, behold, treat with respect, recognition, reverence. Value is not a separate property of a thing, but the essence and, at the same time, the condition of full-fledged genesis of the object. The presence of multiple human needs and ways of feeling explains the existence of the assessment variety: what has a greater value for someone, can be of little or no value for another one. From the formal point of view, values are divided into positive and negative (low-value, no value), relative and absolute, subjective and absolute. By the content the following values are distinguished: material values, logical, ethical and aesthetic values: pleasant, useful, suitable; truth, goodness, beauty

[Philosophical encyclopedic dictionary. Moscow: INFRA-M, 2000].

In economic dictionaries and encyclopedias axiological essence of objects, phenomena and events considered from the philosophical (natural science) positions through value, is reduced to the concept of price and limited to such concepts as “material, not credited values”, “comparison value”, “securities”.

The concept of lean manufacturing cannot be viable on the basis of economic interpretation of the value. Here, the values, measurement units, measurement scales, principles and rules of generalization of **measuring** results proceeding from natural scientific, engineering and technical bases of product (rewards) manufacturing are required. Lean manufacturing as scientific and practical direction should critically reconsider the current economic pseudo-measuring system and create economic measurement system connecting the International System of Units (SI) with the values, units of measurement, scales and methods applied (although very timidly and clumsily) in the Soviet period, in movement “cost-effective management system” and in qualimetry – the science of quality measurement. Unfortunately, LM concept is not yet focused on the generalization of past achievements. But it seems that there is the beginning for this.

The concept of “utility” should be added to LM functional categories. In economic terms, the utility is treated differently: in Great economic encyclopedia there is no special term for this word. A. N. Azriliyan gives the following definition: “Utility is the subjective benefit accrued by the individual from the consumption of goods or services. The classical school of political economics called the utility the value proposition of goods, as opposed to its cost”. So: the value proposition is equivalent to the utility, the utility is opposite to the cost. But what does “cost” mean? According to Great economic encyclopedia: “Cost is: 1) price of goods; 2) cash expenditures for the purchase of goods, executing the works and rendering the services to receive benefits; 3) in labor theory of cost – the labor materialized in product (exchange value)”. Further the authors consider the historical views of the concept “cost” and assert: “After analyzing these views, we can see the bond between such categories as cost and value. The cost of goods is a special case of manifestation of economic value in certain, historically specific conditions”.

Unfortunately, the authors missed one particular story. Namely: 1844. Manchester. England. The young 24-year-old businessman (Friedrich Engels) wrote: **“The cost is the ratio of production expenditures to utility”**. The essence of the described formula is valid in all senses of the modern society. **The fundamental goal** of lean manufacturing is to concretize it and find the quantitative expression of cost manifestation in actual production. In the history of natural science we can find the example of the fundamental law discovery, namely: **“The first law:** any body is in the state of rest or uniform rectilinear motion as long as the forces acting on it do not change this state. **The second law:** the product of body mass by its acceleration equals the acting force, and acceleration direction coincides with the force direction. **The third law:** an equal and opposite counteraction always corresponds to the action; or: actions of two bodies on each other are always equal in value and opposite in direction”. These laws were formulated by Isaac Newton in 1687 [Soviet encyclopedic dictionary].

Do Newton’s laws (laws of mechanics) function in LM system? If so, it is necessary to find their manifestation in philosophy, principles and common concept of LM. If not, to get indulged into illusions (Latin illusion – deception, delusion). **The identification of value with the price, expressed quantitatively with banknotes, is the manifestation of such illusions in LM.**

In what part of LM do Newton's laws appear and are specified? Certainly – "a workspace" and "a workplace" (GOST R 56906 – 2016), the creation of which (research, design, operation, control) and determination of their value is impossible without the laws of mechanics and the magnitudes, measurement units tabulated in the International System of Units (SI) obtained from them.

In what laws is the cost manifested and implemented? **The first Law**: any production is the production of benefits that have utilities for personal and public consumption. **The second law**: the ratio of production expenditures to utility is the cost of benefits. **The third law**: if the expenditures of production of two goods are identical, the utility will be the decisive factor in determining their comparative cost.

F. Engels, developing his definition of cost, at the time stated: "The practical application of the concept of cost will then be increasingly limited to addressing the issue of production, and this is its real sphere". Isn't it so?! The social movement of lean manufacturing should consider this remark in its philosophy, the same way as natural scientists and engineers got intellectually armed with Newton's laws and achieved great success, having created "workspaces", "workplaces" in ISS and "automated workplaces" (AWP) on Moon, Mars and other celestial bodies.

Here, the problem of giving the analytical form to the laws of cost through mathematical functions arises. The second Newton's law can be again taken here as the analog in this transformation: if we designate mass as m, acceleration – as a, and the expression: product of the body mass by its acceleration equals the acting force, then: $F = m \cdot a$, then $m =$ $= 1$ kg, acceleration $a = v / t$, i.e. the ratio of velocity to the movement time $F = m \cdot \frac{v}{t} = m \cdot \frac{L}{t^2}$, Newton (N): $L = 1$ m, $t =$ $= 1$ s. The unit of force measurement proceeds from this formula. It is called in science by the name of its author, who formulated the objective law of nature and social production activities.

It is also possible to convert **the second law** of cost into the mathematical formula: "the cost of benefits is the ratio of production expenditures to utility". Let us identify "the relationship" with the mathematical procedure of "division" $\left(e : U = \frac{e}{U} \right)$; the word "is" – with the mathematical procedure "equal" (=). Then the cost definition is naturally expressed by the formula $C = \frac{E}{U}$, where C – cost; E – expenses; U – utility.

It raises a very important and fundamental question: "Where are the measurement units? They are not available in SI!" The task of finding the measurement units for **expenses, utility and cost** – is the fundamental task of scientists and experts, who took the liberty to start developing the problem of conceptual principle: "to achieve the best results with the lowest expenditures – this is the immutable law of economic management". If you do not deliberately forget the history of economic management in the Soviet (we will not call it socialist and communist) State Planning System in sectorial research activities, you can find both the concepts and disparate methods, formulas and examples of calculating the indexes of expenditures, utilities and very significantly address the experience in developing the science of quality measurement – **qualimetry**, stating its principles in 1967 and is constantly developing its methodology.

In qualimetry the utility is considered from two perspectives: 1) evaluation of certain benefits and resources from the point of an individual consumer or manufacturer; 2) public utility considered as an objective result of manufacturing activity.

In economic and mathematical researches the utility is the category, meaning the result, efficiency of economic decision or activity. Theoretically, the utility can be quantified (quantitative utility) and as the order of some values, moreover, these values are not measured themselves (ordinal utility). Planning authorities distribute resources, plan production, etc., guided by the ideas about what is more necessary and useful for the society. Apparently, to some extent, this is the very process about which Engels wrote in Anti-Dühring that in the future society "the plan will be eventually determined by weighing and comparing the effects of different commodities with each other and amount of labor necessary for their production" [Lopatnikov L. I. Brief dictionary of economics and mathematics. Moscow: Nauka, 1979].

When developing LM methods, it is necessary to take into account the mathematical theory of utility, the subject of which is the numerical representation of the relationship preference criteria so that the greater number corresponds to the more preferable alternative, and the same numbers – to the equivalent alternatives. From a more formal point of view, the mathematical theory of utility studies the utility functions – monotone mapping of ordered sets provided with a variety of additional structures into the space of real numbers. The simplest function of desirability (representation) is the mathematical expression of the geometric mean

$$D = \sqrt[n]{d_1 \cdot d_2 \cdot d_3 \cdot \ldots \cdot d_i \cdot \ldots \cdot d_n},$$

where D – discrete (Latin discretus – divided, intermittent) 1) otherwise – quantization, discontinuity, separation, concatenation; the granulation and atomisticity of the matter are understood under discreteness in natural sciences; d_1, ..., d_n – quantification of the utility of the discrete sequence of properties that make up the overall utility of the product (benefit); private desirability functions d_i; n – number of allocated discretenesses in the considered property.

Private desirability functions quantitatively reflect the utilities of individual properties allocated for pre-accepted measurement scale (it is often called the expert scale, although such scale is just one of many measurement scales).

Regarding the indexes of private consumer properties of products during the Soviet period (1964-1965, Journal "Technical aesthetics") there was an extensive discussion about both the essence of the concept "comprehensive quality criterion" and the number of private quality indexes. Even the brief citation of proposals would be quite lengthy. However, one option of quantifying the criterion was represented by the formula:

$$C_p = \frac{P_p}{E_p},$$

where C_p – comprehensive quality criterion;

P_p – set of useful properties of the product;

E_p – comprehensive economic index.

Debatable problems of quantifying component arguments and generalization function were not solved. The idea of generalization through the concept "qualimetry", scientific area based on the generalized name of quantification of the criterion "Integral index of product quality – indicator of the product quality being the ratio of the total useful effect of the use or consumption of products to the total expenditures costs for its creation and operation or consumption" eventually emerged on the basis of extensive discussions (in 1967) [GOST 15467-79 Quality management of products. Basic concepts and definitions].

Again there was a problem of units for measuring "the total useful effect", i.e. "utility" and "total expenditures". To address the issues of quality measurement in production, the standard referentially gives the example to calculate "Integral index of product quality" by the formula

$$U = \frac{E}{C_{ñ} + C_p},$$

where E – total useful effect of the product use or consumption (e.g., the truck haulage in ton-kilometers during the service life before the overhaul);

C_c – total expenditures for the product creation (design, manufacturing, installation and other one-time costs);

C_p – total expenditures for the product operation (maintenance, repairs and other current costs).

Any of the specialists dealing with practical calculations by the methodology of integral index of product quality, will notice a lot of insoluble contradictions and ask the question: "What is the link between the Russian word "utility" and Latin word "effect"? Is it possible to find measurement units for such values separately and together? The same question arises when comparing the French word "exploitation" with the Russian words "consumption" and "service life". The terminological inconsistency complicates the quantification of their production essence. However, **the particular** example of "the truck haulage in ton-kilometers" allows applying metrological values and measurement units, in particular, 1 ton = 1000 kg, 1 km = 1000 m. It is now possible to introduce the single term – delivery of cargo within time unit just in time – for the entire set of cargo transportation ways (hand luggage, transportation on a hand truck, horse cart, motorcycle, all kinds of cars, steamboats, ships, railroad cars, pipelines, etc.):

$$Q_T = \frac{U_T}{t},$$

where Q_T – transport quality, qualitons/hour;

U_T – movable cargo type taking into account the aggregate of its features defined with qualimetric parameters;

t – duration of time for the cargo delivery to the consumer.

The word "quali" is added to "ton-kilometer" index, meaning that "tons are different" depending on different properties inherent in the product transported from point A to point B. The task of singling out individual properties of cargos characterizing their "transportability" – classification, selection of reference values, units of their measurement is the area of **logistics** – the science and practical methodology of cargo transportation. The quantitative parameters of goods quality in terms of their transportability on various vehicles and flows are developed based on metrology and qualimetry.

It is interesting to note one historical fact. The famous aircraft designer Oleg Konstantinovich Antonov, academician of the Academy of Sciences of the USSR, Hero of Socialist

Labor of the USSR, was deeply indignant at the wrong economic assessments of the created designs of AN aircrafts (in particular, monetary expressions of the return on assets – with each modified design and development of the aircraft the numbers of the return on assets calculated by the methods of "economic science" go down) presented at the meetings of committees of military-industrial complex of the USSR of that time. He appealed to the academician Aganbegyan A. G., who worked at the Academy of Sciences of the USSR. When discussing the problems of interrelation between engineering-designing operational characteristics and economical calculation procedures, Ahanbegyan A. G. suggested to use the word "quality" in its Latin form qualificare – in short "quali" – qualitatively. Many years after the first meeting O. K. Antonov wrote: "One of the attempts to find the constructive approach to solving the set problem offered by us – NEI (national economic indexes), the main of which today could be the gross output in terms of quality and price in terms of quality. Recalling the Latin word qualificare – to define quality, we might call the first index as "quali-gross" and the second – "quali-price". What is the main difference between the indexes proposed by us and the existing ones? Only that they more fully and accurately reflect changes in the product use-value, i.e., the utility, efficiency of its consumption in the society when changing the structure, productivity of labor, integral quality". [Economy and organization of industrial production. // Journal "ECO", Academy of Sciences of the USSR. Siberian Branch. Novosibirsk, 1974. № 4. P. 16].

The proposals of academicians Aganbegyan A. G. and Antonov O. K. to add Latin word quali (quality) as prefix to the indexes "gross output", "price", were not considered serious by the official political economics. On the contrary,

O. K. Antonov was directly and indirectly reproached of “the engineer incompetence in the economic science”. Designer and academician tried to reach out “to the mind and the heart” of those in power, but did not see any, even the slightest change in the methods of economic analysis of aircraft design projects and all scientific and technical progress.

O. K. Antonov wrote: “The question arises: What about accountability across the entire economy, compiled by Central Statistical Administration of the USSR? Can it happen that the indexes will suddenly decrease? For example, 400 thousand trucks were produced, and then – only 350 thousand but of better quality with the output in ton-kilometers, e.g., 1,5 times greater. How to reflect this? Obviously, it is also necessary to account the union statistics in the same units – “quali-gross” and “quali-price”. Our country has the experience in dealing with similar problems. After mastering the production of 15-horsepower tractor “Fordson”, it was required to increase its capacity. And although the 25-horsepower tractor is beneficial to the national economy, the plant will produce less of them. It was decided to divide the total capacity of all tractors by 15 and account in conditional 15-hosepower calculation, assuming with certain approximation that tractor productivity in agricultural works is roughly proportional to its power. The same way, the production of railway cars is accounted in four-axle calculation, etc... The development of indexes has been going in this direction for a long time... the current dual accounting is already the great progress in planning in ferrous metallurgy. The production of mineral fertilizers and plant protection chemicals is given not only in thousands of tons (conventional), but also expressed in term of 100% of nutrients and 100% of the acting beginning. Locomotives are calculated not in pieces, but thousands of sections and millions of horsepower, tractors in thousands of pieces and millions of horsepower, etc. Thus, reporting is gradually improved towards more accurate accounting of measurement of use value of products, which is certainly a welcome phenomenon". [ibid, in ECO].

One can only regret that there were no many engineers in education, designers and technologists in professional activities near O. K. Antonov that would constitute "a skeleton" of enthusiasts, who have long been intrinsically involved in the creation of various qualimetric criteria, values and their units of quality measurement. And we should remind again that in 1967 the group of enthusiasts gathered in Moscow restaurant "Budapest" at the initiative of the military construction engineer G. G. Azgaldov, aircraft production engineer A. V. Glichev, mechanical engineers Z. M. Krapivensky, Yu. P. Kurachenko, D. M. Shpektorov, architect M. V. Fedorov and economist V. P. Panov. The group of technocrats, convinced in methodical similarity of the existing various ways of quantitative evaluation of qualities of different objects, decided to carry out the theoretical generalization of these processes through the development of an independent scientific discipline called "qualimetry".

Unfortunately O. K. Antonov was not in the group of enthusiasts who declared themselves as the adherents of "qualimetry" as the science continuing the theory and exploring the practice of philosophical area of the ancient Greek scientist Aristotle "Axiology" (Greek άξία – value, dignity) as manifested in the three laws of value, particularly, in "**the first law**: every production is the production of benefits that are useful for personal and public consumption". Thus, the production of useful benefits is the production of values.

Perhaps the concepts of "quali-gross", "quali-price" could be disclosed in the calculation of gross output through the following indexes: qualimetric volume of products, qualimetric unit of measurement, qualimetric value of product, the money price of qualimetric unit of product. But for the official (state, international, universal as the (SI) International System of Units in our country – the Russian Federation, it is necessary to have the state-specific official shelter of qualimetry for specialists of science and practice. But it is even more important to have the generalizing scientific area for the association in socio-economic system.

"Essence of LM" stated in standard GOST R 56020-2014, obliges to recognize the term: "67. Qualimetry. Field of science, whose subject is the quantitative evaluation methods of product quality (GOST 15467-79, act 2009), and also the interconnections with standards GOST ISO 9000, GOST ISO 9004 and GOST R ISO 1015. Consequently, the concept of LM becomes the universal (Latin universalis – universal, overall, general, versatile, suitable for all) field of science and administrative (Latin administration – management, leadership: 1) aggregate of public bodies exercising the control functions; 2) administration officials, senior executives of a company, enterprise) system of document management.

What does this versatility of LM mean? Only the declared practice of using economic sentences (Latin sententis – opinion, saying, judgment: 1) saying of moralizing character, morals) of macroeconomists, microeconomists, minieconomists, nanoeconomists and many others from the conglomerate (Latin conglomeratus – accumulated, collected: 3) one of the forms of economic associations of firms without production essence) political and economic **charlatans** (V. I. Dal, vol. 4: charlatan – a liar, boaster and cheater; the one who fools people, shows off, takes away, obscures, plays off in different ways and robs. There is an example: "He knows nothing about the matter, only cheats and the gullible pay for **his charlatanism**)”.

The political-economic charlatanism as “weeds in the field” filled all the socio-economic space with the attributes of the “invisible hand” of the market and included in the official jurisdiction “Article 21. Rights and obligations of a worker; Article 22. Rights and obligations of an employer”. The comparison of the concept “worker” in relation to the concept “employer” sounds insulting, as if a person working at the workplace is sent by the creator of the benefit to the historical past – slavery; the employer is excluded from the workers working at the workplace, i.e., he is only the “giver” but not the organizer of the benefit production. Moreover, “The employer is obliged to: provide workers with equal payments for the work of equal value” (Article 22 of the Labor Code of the Russian Federation). Formally it sounds respectably (French respectable – worthy of respect: honorable, respectable, strange, important), but in the practical labor sphere (in collective employment agreements and results of sharing the monetary revenues) we do not see any concepts or methods of equating: labor = value.

Without solving the quantification of qualitative identity – the amount of labor equals the amount of value – the development of LM philosophy into the active practice is difficult and doubtful, if the management of the country national economy is demonstrated under the banner of “invisible hand of the market”. However, the declared concept of LM was proposed, probably, to make the invisible hand visible and understandable, and for it to obey the objective-natural law of managing production activities: achieving the best results at the lowest cost, expressed on the basis of qualimetric principles quantitatively according to the formula:

$$V_q = \frac{U}{E} ,$$

where V_q – qualimetrically calculated value of specific utility quali unit of the product/quali unit of the expenditures;

U – total volume of qualimetrically calculated utility of the i-th order, quali units/number of units;

E – expenditures of labor means in quali units.

Of course, “the weeds” will yell: “Marketer – INH (i.e., marketer with the invisible hand) does not have quali units, he has only “quali ruble”, “quali dollar”. It is natural to assume that qualimetric units (unit of quality measurement) are available in the arsenal of scientists (physicists, chemists, biologists) and their right-hand men – engineers (designers, chemists, biologists). The emerging medium of lean manufacturing enthusiasts has, needs, is obliged to undertake the compilation of long-term engineering practice (is developing despite INH) of searching measuring units of qualitative characteristics of different types and varieties of products (benefits).

Here, the convincing examples can be taken from the history of origin of measuring units for food for animals and then for humans. “In the first half of XVIII century Thaer proposed the methodology for evaluating feed materials based on the principle of “hay” equivalents. As the name indicates, all feed materials are equaled nutritionally with “hay” in terms of the values equivalent by products manufactured. “... It was found that X weight units of any fodder produce the same feeding effect as 1 kg of hay ...” In 70-ies of XIX century cattlemen in Scandinavia and Denmark proposed a new way to evaluate fodder, the so-called fodder units. 1 kg of oats was taken as the evaluation basis… Later, based on developing physical and chemical sciences, new theories emerged: “starch equivalents” and “therms”... Arisbi – the founder of the doctrine on “therms”, according to which the fodder was measured by the amount of heat energy contained in it, moreover, “therm” is taken as 1,000 large calories” [Aleksandrovsky N. A. Chemistry of fodder. Moscow: Gosizdat of collective and state farm literature. 1934. 200 p. - P. 7-8].

The universal axiological unit of value “fodder unit” equaled to 1 quali kilograms of fodder originated on the basis of **pioneer** units “quali hay”, “quali oats”, “quali therm”. Such physical-chemistry that gave rise to the whole branch of the quality measurement science can be ignored only by inveterate quacking economist “Weeds”.

Let us examine the evaluating (axiological) actions of experts in mechanical engineering production, e.g., let us take “Handbook of designer of engineering plants [Moscow: State Scientific-Technical Publishing House of Mechanical Engineering Literature, 1946]”. “**The repair unit**. To measure the labor intensity of repair works for mechanisms, the conditional repair unit “RU” is accepted, corresponding to the labor intensity of the simple mechanism repair. All the equipment of the plant is divided into groups of repair complexity. The group number indicates the number of repair units (RU) defined by the repair labor intensity of the particular mechanism… The classifiers of the plant equipment distribution into groups of repair complexity are given in the rules on scheduled and preventative maintenance of equipment of the appropriate industries of mechanical engineering” [Vol. 3. P 238]. RU system is still in effect today, despite the “Weed” from the company “Charlatan”.

Polytechnic Dictionary. [Moscow: Soviet Encyclopedia, 1989]. “**The basic part, part-representative,**

equivalent part – the main part, which reflects the structural, technological, overall and other characteristics of the group of products. It is selected for determining the conditional production program, especially, for designing shops and plants. When designing the technological processes of assembly". Isn't it clear that the designers, technologists, production organizers act axiologically and it is decent to call them qualimetric. The measuring unit here is certainly qualimetric – 1 qualipart. The actions of engineers are followed up by the qualimetric analysis and it should be set forth by the methodology developed in our country.

Constructional Materials. Handbook. [Moscow: Stroyizdat, 1989]. "The industry of basic materials. It comprises the production of wall blocks (large blocks and panels of cell and dense silicoconcrete, large and small concrete blocks, slag concrete blocks, blocks of natural stone – shell rock, tuff, etc.), constructional (ceramic and silicate) bricks, ceramic blocks and panels, blocks and panels from bricks, gypsum, papercrete. Wall materials are measured in pieces of **conditional bricks"**. This is followed by the method of calculation in units of conditional bricks but modern "Weeds" does not notice qualimetry here as well.

Statistical Dictionary. [Moscow: Finance and Credit, 1989]. "Units of measuring industrial products – measuring instruments accepted in planning and accounting, in which the amount of manufactured products is expressed. They are divided into natural (physical) – tons, meters, pieces, etc., conventionally natural – expressed by the amount of any product varieties, the consumer property (or technical and economic parameter) of which is accepted as commensurator: cast iron expressed in terms of pig iron, freight cars expressed in terms of four-axle, mineral fertilizers in conventional content of nutrients, soap expressed in terms of 40% fatness, published sheet equaled to 40 thousands of printed characters to calculate the volume of printing matter, reference fuel to calculate the volume of fuel production, conventional reference hectare in agricultural production".

From these measuring instruments we should recognize their methodological similarity with the principles of qualimetry, namely, the use of analog method and selection of the reference point for comparing the properties of group quality (qualimetric parameters) with qualimetric indexes of the basic type of products and services.

Consequently, in the engineering and economic pursuit of objective criteria for calculating the production volume in units, reflecting the multiplicity of quality properties, the action of measuring quality, i.e., the methodology and principles of qualimetry, existed invisibly and exists now. The application of qualimetric method in the concept of lean manufacturing is not only possible but also necessary. But this raises the question of the primary organizational structure, where the interconnection area of LM principles is directly linked with qualimetric values and their measuring units. The modern management system comprises Technical Committee for Standardization TK076 "Management Systems", which proposed to add GOST R 56906-2016. Lean Manufacturing. Organization of Workspace (5S) to the National Standards of the Russian Federation. The primary manufacturing facilities to apply the philosophy, values and principles of LM are recognized and approved by the standard "Workplace" and "Workspace".

The general qualimetric index quantitatively reflects what quality has (what it is filled with) this parameter of the product, i.e., what recorded features and properties the products acquire when being manufactured at the given workplace. When the main parameter is multiplied by the qualimetric index having the quality dimension – quali, then we have: qualiparameter, e.g., qualipiece, qualikilogram, qualimeter, qualisquare meter, qualicubic meter, qualikilogram meter, qualicalorie, etc.

In turn, the general qualimetric index can be expressed as the product of private qualimetric indexes, i.e.

$$K_q = K_1 \cdot K_2 \cdot \ldots \cdot K_m = \prod_{1}^{m} K_j \ ,$$

where K_j – qualimetric index of j-th recorded feature, property that characterize the quality of manufactured products at the given workplace with one particular j-th side.

Each particular qualimetric index is a dimensionless coefficient that reflects the measured or estimated value of specific feature, property inherent to this product, i.e.

$$K_j = \frac{\mathrm{f}\ (q_i)_j}{\mathrm{f}\ (q_\delta)_j} \ ,$$

where q_i – measured or estimated value of the j-th feature, property of the i-th product made at the given workplace;

q_δ – measured or estimated value of the j-th feature, property of the δ-th product made at the given workplace taken as the base (reference).

The functional expressions in the numerator and denominator in formula K_j have the same dimensionalities, so, the value of specific qualimetric parameters becomes the dimensionless coefficient.

The type of functions is derived by methods of mathematical statistics (applied regressive and correlative analysis) by the appropriate processing of the collected statistics on the effect of a particular feature, property of products on the socially necessary (normative) time for its production at the workplace, i.e., the following functional dependence is revealed: $t_j = \varphi(q_j) = A_j$, and the qualimetric index will be expressed as follows:

$$K_j = \frac{(A_i)_j (q_i)_j^{a_j}}{(A_\delta)_j (q_\delta)_j^{a_j}} = \left(\frac{q_j}{q_\delta}\right)^{a_j} = b_j^{a_j} ,$$

since $A_j = A_\delta$ = const for this kind of function.

Qualimetric equation of the workplace. From the foregoing it follows that the general qualimetric index of the products manufactured at the workplace, will be expressed by the following formula:

$$K_q = \prod_1^m K_j = A \cdot b_1^{a_1} \cdot b_2^{a_2} \cdot \ldots \cdot b_m^{a_m} .$$

This function is nothing else but **the production function**.

The multiplicative forms of production functions are widespread in economic and mathematical studies. Their advantage is as follows: if one of the multipliers equals zero, the result is zero. It is easy to notice that it realistically reflects the fact that in most cases in production all analyzed primary resources are involved, and without any of them the product output appears to be impossible. The multipliers b_i from the first to m-th can have different contents depending on what factors influence the overall result (output). The power coefficients indicate the fraction of the growth in the final product, which is added by each of the multipliers. If the total of coefficients is one, it means the function uniformity: it increases in proportion to the amount of resources. But there can be such cases, when the total of elasticity coefficients (parameters of the production function) is greater than one. This shows that the increase in costs leads to the disproportionately large increase in output. The method of production function on the basis of qualimetric analysis can be developed, in particular, in the direction of the development of special production functions, tailored to specific conditions of workspace, workspaces, types and classes of products.

Judging by the available literary sources, we can ascertain that there is no production function for the workplace, in the sense proposed by us, therefore, the qualimetric approach to the calculation of volumes of product output opens up ample opportunities for economic and mathematical modeling at the workplace level – primary element of workspace (production systems). The equation of production function of the workplace we derived contributes to the development of the theory of production functions. We called the production function of the workplace as **the qualimetric equation of the workplace**.

Legal and regulatory provisions and documents, among which the requirements and provisions of the Labor Code of the Russian Federation are the major ones, are particularly important in LM management system. Implementation of the philosophy, values and principles of LM requires the approval in general, by sections, by articles and comments to articles of the Labor Code, however, the most important is the following article: “Section III. Employment contract. Chapter 10. General provisions, namely: Article 56. The concept of employment contract. The parties of the employment contract; Art. 57. The content of employment contract; Art. 58. The term of employment contract; Art. 59. Fixed-term employment contract; Art. 60. Prohibition to demand the execution of work not fixed in the employment contract; Art. 60. p. 2. Multi-tasking (multi-positioning); Art. 63. The age at which it is permitted to sign the employment contract; Art. 64. Guarantees when signing the employment contract; Art. 65. The documents presented when signing the employment contract; Art. 66. Work-book; Art. 68. Registration of employment".

For an individual approach to a personality in the area of lean manufacturing impact, the most important is the requirement of Art. 57. The content of employment contract: "The following conditions shall be obligatory included in the employment contract: workplace; labor function; date of commencement of work; wage conditions; working hours; time of rest; compensation for heavy work and work in harmful and (or) hazardous working conditions; conditions determining, where appropriate, the nature of work; conditions of compulsory social insurance".

There is no univocal, definite document comprising the foregoing and other requirements of labor legislation in the complex of LM standards. However, the recognition of "workplace" and "workspace" as the primary LM objects allows proposing specific documents for them: "Passport of workplace" and "Passport of workspace". The development of these documents would be one of the most important functions in the organizational structure of LM. The content of these documents is, to some extent, already available in the classification system of scientific and legal, psycho-physiological and economic information. There are samples of passports with their meaningful informational content.

There is sufficient experience in the mechanical engineering industry on the application of principles and methods of qualimetry in the calculations of quantitative parameters that form the basis of indexes of the quality of work processes at workplaces. To prepare the passport of workplace it is necessary to perform the qualimetric analysis of the properties, features, parameters of all means of production constituting the workplace structure, determining the quantitative quality indexes. The most significant qualimetric indexes of the workplace are:

Category I – Engineering-qualimetric;
Category II – Physiological-qualimetric;
Category III – Psychological-informational.

MEASURING LABOR COSTS IN LABOR-HOURS

The physiological aspect of the labor process can be quantitatively expressed by the coefficient of labor physical intensity, and the intensity of purposeful activity during this type of labor – through the coefficient of labor intellectual intensity. Then labor costs

$$T_p = K_{pi} \cdot K_{ii} \cdot t \,. \tag{13.1}$$

Let us recall the coefficient of physical intensity

$$K_{pi} = \frac{1}{E_b}\left(\frac{1}{E_0} + a \cdot \frac{A}{500}\right) \cdot K_m \cdot K_y$$

and the coefficient of intellectual intensity

$$K_{ii} = \frac{\ln N}{e^{1-p}} \cdot \Delta \,,$$

where E_b – energy cost by the human body in the process of labor taken as the basis, kcal/min; E_0 – energy costs for maintaining the initial posture (standing, sitting), kcal/min; a –

coefficient expressing the ratio of static and dynamic load on the body; A – mechanical work performed by a person in the labor process, kgm/min; K_m, K_y – coefficients, which take into account the influence of climate and ambient air conditions on the body energy consumption; N – number of objects of attention in the given labor process; p – value of irregularity (uncertainty) of the given labor process; Δ – value of relative intensity of information processing in the investigated labor process.

The product $K_{pi} \cdot K_{ii}$ characterizes the intensity of the labor process, i.e., the intensity of the "labor live being".

Every product of labor acts as capacity:

a) nature substances;

b) properties consumable for people and public life;

c) labor costs.

Each single labor process (production operation) is an elementary component of the general aggregate of individual processes of actually social labor. For some aggregate of operations we have the following technological labor intensity:

$$T = \sum_{i=1}^{k} T_{p_i} = \sum_{i=1}^{k} K_{pi_i} \cdot K_{ii_i} \cdot t_i \text{ (labor-hour)} \qquad (13.2)$$

where T_{pi} – labor costs for the i-th technological operation;

i = 1, 2, 3, ..., k – numbers of successive technological operations to manufacture the product type under consideration;

t – duration of operation at i-th technological operation (piece-time).

When all the values in the formula are determined based on the standards, we have **normative labor costs** expressed in labor-hours. If these values are determined on the basis of fixing the actual parameters, features and properties of actually performed labor processes, we have **actual labor costs** expressed in labor-hours. In production practice the technological labor costs are found by the formula

$$T = \sum_{i=1}^{k} t_i \text{ (hour)},$$

i.e., they are obtained by summing the norms of time (hour) for all technological operations for manufacturing this type of product. This shows that the formula we proposed is essentially amended for physiological energy costs and feasible information processing. The proposed formula adequately quantifies the essence of technological labor costs of product manufacturing through "quantitative living labor being" and the immanent measure of this being – working hours.

It is advisable to show some of its features.

I. K_{pi} = 1,0 , K_{ii} = 1,0 , t = 1,0 hour, and, therefore, the labor costs (labor intensity) of T = 1,0 labor-hour. What is the real content of this value – 1 labor-hour? It becomes clear when disclosing the essence of labor physical and intellectual intensity coefficients. Indeed

$$K_{pi} = \frac{1}{E_b}\left(\frac{1}{E_0} + a \cdot \frac{A}{500}\right) \cdot K_m \cdot K_y \ .$$

Let us assume that K_{pi} = 1,0, E_b = 2,1 kcal/min, K_m = = 1,0, K_y = 1,0, E_0 = 0,7 kcal/min, a = 1,0. Then the mechanical work performed by a person in the labor process A = 700 kgm/min. This corresponds to walking at the speed of 4 km/hour under normal climatic conditions and favorable air environment.

Further, in the formula of labor intellectual intensity coefficient

$$K_{in} = \frac{\ln N}{e^{1-p}} \cdot \Delta$$

we take K_{in} = 1,0, Δ = 1,0, F = 1,0. Then ln$N$ = 2,72, which corresponds to the number of objects of attention N = 15. This is entirely simple work. (Compare with manually loading a truck with quarry stone when there are 17 objects of attention).

Thus, 1 labor-hour is a quantitative characteristic of a simple work process with average physiological severity, and can be applied as a measuring unit and main dimensionality of labor costs. The introduction of this unit eliminates one-sidedness, inaccuracy and inadequacy of the index "technological labor intensity" used in practice.

II. Change in the labor duration value without changing the essence of the process leads to an increase or decrease in physical and intellectual intensity value. Let us assume that t changed and became t_1, and $t > t_1$. How did K_{pi} and K_{ii} change? We assume K_{pi} = 1,0 and K_{ii} = 1,0 at t_1 = 1,0. At constant data E_b, E_a and "a" coefficient of physical intensity varies with the change of mechanical work performed in the unit of time. But the change in duration value causes changes in the motion rate of the system man – labor tool – subject of labor, and, consequently, the mechanical work performed by the man in the unit of time increases or decreases. The latter causes changes in the coefficient of physical intensity.

The value of labor intellectual intensity coefficient depends on the complexity and speed of information processing. The change in the duration of labor process does not affect the labor complexity, but it causes changes in information processing speed, in other words, the number of objects of attention remains the same, because the essence of labor process remains unchanged, but the rate of establishing relations with these objects of attention varies due to the increase or decrease in the duration of labor process. So, the change in the duration of labor process causes the increase or decrease in the intellectual intensity of the human, the performer of this work.

III. Change in the essence of the labor process causes changes in all labor intensity parameters (K_{lb}, K_{yn}, t). There can be several options. It is possible to simplify the labor process by reducing the number of objects of attention, which decreases the duration of the given labor process, without affecting the physical intensity. The work facilitation due to the introduction of mechanisms can cause the increased duration of labor process, etc.

Thus, the result of any organizational and technical measure introduced into the production can be quantitatively expressed through the change in the value of labor costs (labor intensity). Moreover, the estimate can be given at the stage of designing the technological process and developing the plans of organizational and technical measures.

The following encryption system can be proposed for the evaluation: P – physical intensity; M – microclimate; A – air environment conditions; I – intellectual intensity; D – duration of labor process.

Each type of work or technological operation has its own code based on the system adopted at the enterprise. To fix the results of the labor process evaluation, the code is added to this system following the encryption system described here. Let us consider a hypothetical example: IZHYU 3-71 turn. 51P1,20, M1,07 A1,15 I1,48 D0,06. Decoding of this designation:

The machine of IZHYU make.

The part number 3-71.

Turning operation, No 51.

Coefficient of physical intensity, K_{pi} = 1,20.

Microclimate coefficient, K_m = 1,07.

Coefficient of air environment conditions, K_a = 1,15.

Coefficient of intellectual intensity, K_{ii} = 1,48.

Piece calculation time, t = 0,06 hr.

Technological labor intensity (labor costs):

$T = K_{pi} \cdot K_m \cdot K_c \cdot K_{ii} \cdot t = 1{,}2 \cdot 1{,}07 \cdot 1{,}15 \cdot 1{,}48 \cdot 0{,}06 =$ $= 0{,}13$ labor-hours.

Let us assume that the modification is developed during this operation resulting in the following operation code: IZHYU 3-71 turn. 51P1,20 M1,00 A1,00 I1,48 D0,05. The physical intensity remains the same. These measures allowed improving the microclimate and air environment conditions and reduce K_a and K_m. The labor complexity and intensity of information processing are the same, the duration decreased to 0,05 hours as a result of improving the sanitary and hygienic conditions.

The labor intensity after the innovations were introduced is as follows:

$T^1 = 1{,}2 \cdot 1{,}00 \cdot 1{,}48 \cdot 0{,}05 = 0{,}089$ labor-hours.

The effect can be expressed through saving labor costs for 1 part:

$E = T - T^1 = 0{,}130 - 0{,}089 = 0{,}041$ labor-hours, and for annual program with P = 150,000 parts:

$E_g = E \cdot P = 0{,}041 \cdot 150{,}000 = 6150$ labor-hours.

This shows that even the result of measures for improving the sanitary and hygienic working conditions can be quantitatively expressed through the labor cost reduction. As it is known, currently it is almost impossible to quantify the effectiveness of such actions, if it does not directly affect the reduction of work duration and tariff rates or other conditions of work remuneration.

IV. For the purposes of aggregative planning and forecasting of technological labor intensity, it is possible to use the average values of the coefficients of physical and intellectual intensity derived on the basis of industrial statistics of the parameters of technological processes of the given, e.g. mechanical engineering, industry. Then

$$T = K_{pi} \cdot K_{ii} \cdot \sum t_i \, . \tag{13.3}$$

It is possible to draw some conclusions from the consideration of the labor process as the process of information processing by a human.

1. Analytical method for determining the labor complexity through the amount of information processed in comparison with the existing and described methods allows:

a) objectively calculating the complexity of different types of work due to the concept of the object of attention we have introduced and the use of logarithmic measure of measuring the amount of information (diversity) processed by a man in the course of work;

b) applying quantitative methods for calculating the complexity of both the processes of physical and intellectual labor.

2. The resulting expression of the complexity coefficient is, according to the published materials available to the author, the first attempt to give the mathematical model of the intellectual aspect of labor process.

3. The result of this study is the differentiation of the general information processed by a person into individual private groups of information in accordance with the ordinary moments of labor (information about the object of labor, tools of labor, information in the subject of labor, etc.).

4. The derivation of analytical expression of the complexity and intellectual intensity of labor process would be very difficult or almost impossible without the application of the law of requisite variety, the law of experience and methods of reference point, taken from the general theory of similarity and qualimetry, to labor processes.

5. A few examples of complexity calculations are only the beginning of the practical check of the corresponding theories and practical methods of qualimetry as applicable to labor processes. One of the applied methodologies of qualimetry presented here meets the requirements of GOST 15467-79 (2009) to solve the tasks by par. 56 "The quality of worker's labor depends on the labor complexity, qualification conditions, skills, psychophysiological state of the worker (his capabilities) and his attitude to work (the desire to perform the task in accordance with the established requirements). In turn, the labor quality of worker (team), along with other factors, affects the quality and quantity of consumed products manufactured and used by him".

6. The consideration of the public practice of measuring labor processes from the standpoint of modern theory of cybernetics, information, ergonomics and qualimetry proves the correctness of S. G. Strumilin who proposed in the 1926-30-ies already **thread** and its mathematical formula $T_R = 0{,}8 + 0{,}2R$ as the labor measurement unit.

One can only regret that the "revolutionaries" of socialism of the late 20-ies of the last century completely obstructed the proposals of future academician of the Academy of Sciences of the USSR.

7. Figures of "mature socialism" of the late XX century also dealt with the measuring unit of labor costs – "workday", which had been successfully used in practice in collective and

state farms for over 50 years. It is appropriate to mention the provisions of one document. "Based on the study of collective farms experience, the People's Commissariat of Agriculture of the USSR (Narkomzem) following the order of the Central Executive Committee of the USSR (CEC) in its decree of 28 February 1933 set for a rough estimate in workdays of various agricultural works for collective farms, breaking them down into 7 groups. Thus, a collective farmer who fulfilled the output norm of works referred to group 1 was credited with 0,5*T*; to group 6 – 1,75*T*; to group 7 – 2*T*. For example, for spring plowing with two-furrow plough, the daily output norm was 1,20 ha. This work is referred to group 5, which means that for the implementation of this output norm the collective farmer should be credited with 1,5*T*. If the farmer plowed only 0,8 hectares during the day and did not fulfill the norm, instead of 1,5*T* he will be credited only with 1*T*, and vice versa, when over-fulfilling the norm, say, by 1/3, he will be credited with 2*T* instead of 1,5*T*, and so on.

Making the production plan, each collective farm, based on the volume of all works, establishment of output norms and their evaluation in workdays, determines the total number of workdays required to fulfill the production plan of the collective farm as a whole. The evaluation of each work in workdays must be known to the collective farmer in advance (for poor work the workdays are not credited). Moreover, additional workdays are credited to team members for the best performance indexes (harvesting above average from the lot allocated, increase in milk yield of cows, complete safety of young stock, greater stock fatness) and deduction from the income of up to 10% of workdays for the worst performance. This dependence of collective farmer's income on the results of his labor creates the necessary conditions for each farmer's interest in improving the productivity and quality of work” [Agricultural dictionary-handbook. Third edition. Revised. Moscow-Leningrad. 1937. 2950 articles with 850 illustrations in the text].

The same dictionary-handbook gives the definition of the measuring unit of fodder quality – **fodder unit**. Based on this unit, the productivity of agricultural production is determined by comparing the total amount of fodder units in fodder production with labor costs calculated in workdays.

It is proposed to measure all intermediate technological works in relative (reference) hectares of plowed land. Using such measuring unit, the productivity of agricultural works is expressed based on the comparison objects of relative (qualimetrically calculated) hectares with the number of workdays spent for their implementation.

8. We can only pathetically exclaim: “Isn’t it qualimetry?!” And then to note again: qualimetry is a theory that has emerged from the centuries-old practice of quality measurement. We have only to regret that “effective senior executives of perestroika” do not want to see the progress of science, which has deep roots in history.

14

Measure of labor in convertibility of currencies

SUMMARY

At the beginning of “perestroika”, when the USSR was still convulsively thriving, a number of international organizations in the person of Furth Foundation decided to hold an international competition for the best project of converting the Soviet ruble among stable international currencies.

Furth foundation
Furth building, suite 1000
201 Sansome Street
San Francisco 94104
Tel.(415) 433-2070

July 2, 1990

Dear Furth Ruble Prize Competition Participant:

The Furth Foundation, USSR Academy of Sciences – Institute of Economics and the Esalen Institute Soviet-American Exchange Program thank you for your participation in the Furth Ruble Prize Competition.

We felt thank you would be interested in knowing which papers won the prizes awarded. After several months of review and two days of deliberation, the jurors concluded that no one paper provided a single best approach to achieving ruble convertibility. Rather, the jury decided to award prizes to six papers, three as a joint first prize of $10,000,00 apiece, and three as a joint second prize of $4,000,00 each. The list of winners is enclosed.

There were over 600 papers submitted from countries around the world. We are considering the possibility of publishing the winning papers and will provide you a copy if they are published.

Thank you again for your interest in this competition.

Respectfully yours,
Frederick P. Furth
Chairman

The Furth Foundation
presents this Certification of Commendation
in recognition and appreciation for your submission
to the Furth Ruble Prize International Competition

The Competition spanned the years 1988, 1989 and 1990 and gathered over 600 papers from around the world which offered solutions to the problem of Soviet ruble convertibility.

Your contribution to this important competition, an international effort which enlisted the goodwill and talents of people throughout the world, was greatly appreciated.

Dated this 2nd day of July 1990
Frederick P. Furth,
Chairman

SOLVING THE PROBLEM OF RUBLE CONVERTIBILITY AGAINST DOLLAR

In the contest, as evidenced by the results, an unusually large number of specialists (more than 600 bids) participated.

Among the participants of the competition was also Yury Semenovich Perevoschikov with his proposals on changing the money system based on the measure of labor [Per Yu. S. Economic metrology. Search for a measure of justice. Part 1. Philosophy of everyday life. Moscow: IPK Publishing house of standards. Izhevsk: Perseus, 1996. 138 p]. He proposed the method for solving the problem of ruble convertibility against dollar on the basis of their labor content. To this end, he proposed the measure of labor, minimum consumer basket and method of calculating labor costs in the production of goods included in the consumer basket. His proposal to address the ruble convertibility problem was as follows.

The task of solving the problem of ruble convertibility, apparently, is a particular task of the worldwide problem of mutual convertibility of currencies. At the present stage of world development, the scientific resolution of this problem on the basis of the gold content of national monetary units is hardly possible. It seems advisable to consider the task of convertibility of currencies and, in particular, the ratio of ruble and dollar in terms of their labor content.

From the history of economic science it is known that K. Marx came to the scientific conclusion that “... each individual manufacturer receives back from the society, with all deductions, exactly as much as he gives to it. What he gave to the society is his individual, labor share ... He receives the receipt from the society that he has delivered such amount of labor (after deducting his labor in favor of public funds), and on this receipt he receives such amount of commodities from the public stock, for which the same amount of labor has been spent. The same amount of labor that he gave to the society in one form, he gets back in another form ...” [K. Marks, F. Engels. Coll. V.19. P.18].

It is not necessary to prove that K. Marx did not adapt his researches to some national states but, on the contrary, his scientific conclusions arose as a result of analysis of the world economic development.

Proceeding from the above methodological conception, the solution of the problem of ruble convertibility against dollar is suggested in the following succession:

l. The initial mathematical presentation of the problem:

$$R = K \cdot D;\ \ K = R / D, \tag{14.1}$$

where R – ruble; D – dollar; K – converter.

2. Let us choose the list of consumer goods that make the minimum consumer's basket: food products and clothes.

3. For each kind of product in the minimum consumer's basket (potatoes, carrots, bread, shoes, hat, overcoat, shirt, dress, etc.) we develop or take the technological process of manufacturing with detailed description of each technological operation available in the USA.

4. Labor costs are calculated for each technological operation in accordance with its parameters and technological modes and conditions of labor, taking into account the hardness, complexity, and conditions of labor at each workplace. Step-by-step labor costs are calculated by the formula:

$$T_i = K_{ini} \cdot t_i = P_i \cdot C_i \cdot B_i \cdot t_i \text{, labor-hours,} \tag{14.2}$$

where T_i – labor-hours; P_i – physical intensity of labor at the workplace; K_{ini} – coefficient of labor intensity at the workplace; C_i – intellectual complexity of labor at the workplace; B_i – sanitary-hygienic and other conditions of labor unattractiveness at the workplace; t_i – duration of the labor process at the considered technological operation, hours (minutes); i – index of the parameters belonging to the i-th technological operation.

We suggest formulas for calculating physical intensity of labor at the workplace (P), intellectual complexity (C), and labor unattractiveness conditions (B).

The empirical formula of labor hardness:

$$P = 1 / 2{,}1 \cdot (A / 4189 + M / 443 + \Delta E)\ , \tag{14.3}$$

where A – work done by a person in the labor process at the given technological operation, J/min; M – static moment in aggregate maintained by a person in the process of labor, J; ΔE – additional energy spent by a person in the process of his work in order to overcome the unfavorable labor conditions.

The intellectual complexity of labor at the workplace:

$$C = \ln N \cdot e^{N_a / N}, \tag{14.4}$$

where N – number of the algorithm elements in the technological operation;

N_a – number of the algorithm elements that have logical uncertainty in their resolution (algorithm elements with logical conditions);

e – base of natural algorithms.

The level of labor unattractiveness:

$$B = B_i / B_0, \tag{14.5}$$

where B_i – estimation of the physical state of labor conditions at the *i*-th workplace in marks;

B_0 – estimation of the favorable slate of labor conditions taken for the measurement base in marks.

The algorithmic description of labor process and the parameters calculation are based on the application of microelement system of MTM (methods of time measurement) to the analysis of labour processes.

The measure of labour in our method is the labor process with the duration of t = 1 hour and intensity level $K_{in} = P \cdot C \cdot B = 1{,}0 \cdot 1{,}0 \cdot 1{,}0 = 1{,}0$.

Such process can be described and all its factors can be expressed quantitatively.

5. Labor costs are calculated for the totality of technological operations and product types in the minimum consumer's basket by all their component parameters (*P*, *C*, *B*, *t*), i.e.

$$T = \sum_{j=1}^{n} \sum_{i=1}^{k} , \tag{14.6}$$

where i – list of technological operations;

j – list of product types.

6. Simultaneously with calculating the labor costs we determine the sum of wages that should be paid for the manufactured products in the consumer's basket. The wages are calculated in dollars by the system of payment existing in the USA, and in rubles, for the same labor costs, by the system of payment existing in the Russian Federation. The wages are calculated for each technological operation by the formula:

$$V_{Di} = \mu_D \left(1 + \frac{m_D}{100}\right) t_i , \tag{14.7}$$

$$V_{Ri} = \mu_R \left(1 + \frac{m_R}{100}\right) t_i, \qquad (14.8)$$

where V_{Di} – wages to be paid in dollars at the i-th technological operation; V_{Ri} – wages to be paid in rubles at the i-th technological operation; μ_D – hourly tariff rate in dollars in the US labor payment system; μ_R – hourly tariff rate in rubles in the Russian labor payment system; m_D – bonuses and different additional payments in the US labor payment system, in per cent to hourly rate (maximum values are taken); m_R – bonuses and different additional payments in the Russian labor payment system, in per cent to hourly rate (maximum values are taken); t_i – fixed duration of process at the i-th technological operation, hours.

7. Wages in dollars (V_D) and rubles (V_R) are calculated for the totality of technological operations and product types in the minimum consumer's basket, i.e.

$$V_D = \sum_{j=1}^{n} \sum_{i=1}^{k} V_{D_i}, \qquad (14.9)$$

$$V_R = \sum_{j=1}^{n} \sum_{i=1}^{k} V_{Ri}. \qquad (14.10)$$

8. Dividing the calculated value of wages in dollars (V_D) and in robles (V_R) by the labor costs (T) we have the cost of one labor-hour in dollars and in rubles, i.e.

$$C_{TD} = V_D / T; C_{TR} = V_R / T. \qquad (14.11)$$

9. The convertibility coefficient will be as follows:

$$K = C_{TD} / C_{TR}. \qquad (14.12)$$

10. Illustrative example. The minimum consumer's basket comprised 25 names of goods including 10 food products, 12 – clothes, 3 – footwear. Studying the US manufacturing conditions technology, rating of technological operations by the parameters of hardness, complexity, labor process conditions and duration permitted to calculate the labor consumption which came to 1,800 labor-hours. The workers' wages were 8,000 dollars or 12,000 rubles.

The cost of 1 labor-hour in dollars – C_{TD} = 8,000 / 1,800 = 4,441 dollars/labor-hour.

The cost of 1 labor-hour in rubles – C_{TR} = 1,200 / 1,800 = 0,67 rubles/labor-hour.

The converting coefficient K = 4,44 / 0,67 = 6,627. Thus, in order to provide the equivalence of ruble and dollar purchasing power, it is necessary to pay 6 rubles 63 kopeks for 1 dollar.

11. The proposed option of solving the problem of ruble convertibility can be organizationally realized by a provisional creative team comprising technologists, production organizers, financiers equally from the USA and Russia. Apparently, the most complicated scientific task will be in coming to an agreement on the measure of labor and methodology of labor cost calculation. The achievements in the fields of labour physiology, engineering psychology, information theory, and labour rating will allow overcoming this difficulty with full confidence in scientific truth.

As a result of the competition, 5 prizes were awarded. Yu. Perevoschikov was given only the certification of commendation. The awards were handed and probably materialized by the prize-winners in their personal lives. However, it is sad that the object of convertibility itself – the Soviet ruble – disappeared from the world arena. Did the organizers of the contest expect such outcome?

RESULTS OF FURTH FOUNDATION COMPETITION

The successors of the Soviet ruble became the "elder brother" – the Russian ruble with a two-headed predatory bird and fourteen "younger sovereign independent brothers" of the CIS minted birds, beasts and personalities. Has the world situation improved in this regard? Modern circumstances and an endless series of tense situations in the world increasingly create pessimistic mood of people.

In 1993, Margaret Kennedy published the brochure entitled "Money without interest and inflation (How to create a means of exchange that serves everyone)". She appeals to readers to participate in changing the world monetary system. But how can the broad masses manifest themselves in such intricate system as the modern interest monetary economy?

She writes: "If we agree with the existence of public structures, which in their essence are directed against these goals, then social justice, environmental survival and public freedom are under threat".

The author's practical proposal bears a certain shade of hypotheses, but they excite the thought, force everyone to leave his little world, the vicious circle of "compound interest" on invested capital and look at the problem from the positions of all mankind, proceeding from the interests, as Academician V. I. Vernadsky would say, the entire noosphere of Earth [Per Yu. S. Economic metrology. Search for a measure of justice. Part 1. Philosophy of everyday life. Moscow: IPK Publishing house of standards. Izhevsk: Perseus, 1996. 138 p].

Later, the article about this contest entitled "What did the closed competition reveal?" appeared in the newspaper "Izvestia". This is what I. Ognev wrote in it. "Let me remind you how this much-promising for our country event started.

The American lawyer and multimillionaire Frederick Furth, reflecting on how can he, a descendant of the Slavs, help the Russian perestroika, proposed the idea of the competition and allocated 100 thousand dollars for its implementation. Other $20,000 were contributed by the Esalen Institute and Soviet-American Exchange Program. The jury from the USA consisted of well-known people: Professor of the University of Arizona Joseph Brada, Professor of Duke University Anna Kruger, Nobel Prize winner in economics Vasily Leontiev and employee of the Brookings Institution Dr. Ed Hewatt. The Soviet side was also solidly represented: academician Abel Aganbegyan, deputy. Chairman of the GBC Ivan Ivanov, Deputy Director of the Institute of Economics of the USSR Academy of Sciences Boris Milner and then Deputy Director of the Center for Theoretical and Experimental Physics of the Academy of Sciences of the USSR, and now – Adviser to the President of the USSR, Corresponding Member of the USSR Academy of Sciences Nikolai Petrakov. Three prizes were set: 20, 10 and 5 thousand dollars.

As a result, more than 600 works arrived from 23 countries, including 442 projects from the USSR.

The final is known. The first prize was not awarded, as “no one paper provided a single best approach to achieving ruble convertibility”.

Three prizes of 10 thousand dollars were awarded to G. Anulova and K. Panov (both from the USSR) and F. Holtzman (USA). Another three prizes of $4,000 each were awarded to S. Dzarasov (USSR), J. Kelen (Hungary) and K. Schafel (Germany).

And soon “Izvestia” editorial board began to receive letters, whose authors asked puzzled questions. For example, like this:

"Why was the competition announcement published in "Socialisticheskaya Industria", the newspaper known not to be mass, on July 30, 1989, while in the mass one – "Argumenty i Fakty" – only in early November? Because of this, many Soviet participants lost three months".

"Why out of 442 works from the USSR only 11 were sent to the USA, and the rest were cut off at the preliminary stage? After all, this manipulation of the competition conditions was not envisaged. Knowing in advance that the work will be reviewed not by the jury members whose names were published, but the staff of the Institute of Economics of the Academy of Sciences of the USSR known for its relations with the government, we would not spend so much time, effort and money", wrote the correspondents of "Izvestia".

Here is what in his interview to the newspaper "NTR" B. Milner said in this respect, who, apparently, was dealing with the whole organizational, and partly the content-related side of the matter. I will point out in brackets that the professor himself is an expert in management and organizational structures. So, "we have reviewed all the works. After selecting the projects that meet the competition conditions, we subjected them to so-called cross-review. At the first stage of the selection, we had 85 works left. We divided them among jury members, but at the same time created the working group of specialists who also got acquainted with their content and developed their qualified judgments.

At the next stage, we exchanged the selected works with the American part of the jury, and only then, to the meeting of the international jury, each side had to choose 10 projects. But it turned out that we selected 11, and American colleagues 16".

Judging by the letters and calls of our readers, the passage by B. Milner did not explain, but only darkened the situation. In fact, how could the work of our compatriot reach the final stage and even get the prize, if its content, according to the terms of the contest, should be the "result of scientific research" of the applicant, and he was not engaged in these studies, as the list of his works eloquently testifies.

I will not suppress that I mean, in particular, S. Dzarasov, Head of the Department of Political Economy of the USSR Academy of Sciences. By the way, this department is located in the building of the Institute of Economics of the USSR Academy of Sciences. And next door, on the same floor, is the office of R. Shiryaeva, the Academic Secretary of the contest from the Soviet side. And here are the puzzles which one of the contest participants – R. Smirnov – faced in this secretariat. He could not get the answer to the simple question there: Was his work sent to the USA or not? The assistant of R. Shiryaeva gave him only such explanation: The manuscripts sent overseas were not registered, everything was done on the basis of mutual trust, the American put the works into his suitcase and left.

The mutual trust between our two countries is wonderful. But we should not lose this quality in relations between compatriots. After all, the suspicions that the Soviet half of the contest "kitchen" is not entirely clean, have arisen not today. Here is what, for example, the well-known economist Professor Viktor Belkin told the correspondent of "Kommersant" about the anonymity of the competition and especially the semi-annual pre-selection at the Institute of Economics of the USSR Academy of Sciences:

- I do not believe that professionals in the field of ruble convertibility, who have never been known before, could suddenly demonstrate the world level of developments... I have never heard before about any works on ruble convertibility by the winners of this strange competition.

In principle, it would have been possible to object to Professor Belkin, because the unconventional, partly daring opinion of the “outside expert” sometimes gives enviable results. However, this statement is unlikely to be true in our case. Now, when the winners’ works are published in issue No 9 of “Voprosy Ekonomiki”, everyone can be convinced that Professor Belkin, alas, is not far from the truth. If the Soviet prize-winners basically declare “conceptual” messages, by the way, contradictory to each other, their foreign colleagues propose carefully worked out and, what is crucially important, internally non-contradictory organizational and financial-economic mechanisms for the transformation of our economy. That should ultimately convert the ruble.

The concepts will also be useful for us for the beginning. After all, after many years of storming the depths of political economy of socialism, we slanted off from the highroad of civilized countries too much. However, let us come back to the conditions of the competition, and we can see there that works should also “contain a practical plan for ruble convertibility” and “be practicable”. But this is already more difficult: a concept is a concept...

“It is perplexing”, writes Professor A. Zhukov to the editors, “how the really poor works could be among the best... I think this could happen only with external support or against equally poor works that were handed to the main jury due to the violation of the competition conditions. In any case, these assumptions need to be checked”.

This is what some contestants tried to do. They demanded to provide them with the copies of reviews and decisions about the reasons of their works “cutting off”. For instance, a member of the jury B. Milner replied to B. Antonov that he cannot satisfy his request because of the “closed nature of the competition”.

V. Kireev demanded to return his work and give guarantees that his ideas in accordance with the copyright rules will not be used without the author's consent. V. Kireev did not receive a substantive reply. He was only advised to address Furth Foundation, because the Institute of Economics only "kindly agreed to help the Foundation" to hold the competition. That is, not without reason, the author of the letter to the editorial board sneers – to help the Americans cope with our problems.

I would like very much to be mistaken, but it seems that when watching the collapse of our own economy, the Soviet jury members were much less interested in how to get this economy out of the deep abyss than their American colleagues.

Yes, but "are you sure it really happened", I mean, the competition as a free competition of minds and ideas as planned? Was one of the most perspicacious observers right who claimed that the competition was used by those of our functionaries who, shielding themselves with prizes, wanted to approve their approaches to reforming the economy, including the ruble convertibility? But if this statement is wrong, how can one explain the fact that the works of the most qualified authors did not reach the final stage of the competition? And such authors, according to the editorial board, did not ignore the competition, and it is even harder to suspect them in having written a glaring nonsense...

Therefore, the readers' suggestions seem quite appropriate to me: to recognize the results of the competition as invalid, apologize to the initiators and sponsors from the American side.

To review again all works without exception and in strict accordance with the terms of the competition, to publish their list: publicity is publicity. Perhaps to replace the jury members from the Soviet side.

To think over the mechanism for selecting and using all valuable ideas in the course of reforms while respecting the norms of copyright.

To report in press where the funds, and considerable funds, were spent.

What is there to add? If we reform our economy with the same diligence with which this competition was conducted, we will naked and hungry for a long time" [Ognev I. What did the closed competition open? // Izvestia].

The modern scientific life is represented by various schools that have diverse views on various research models. For this reason, a wide range of regions with diverse approaches can really offer a set of alternative schemes in the development of possible variants of ruble convertibility. It should be borne in mind that the choice of 11 works by the jury members could be based on the fact that the rest of the works could only be the repetition of one another in one way or another, because they were based on the scientific approach of the scientific school, and sending a large number of similar works on the decision of ruble convertibility simply did not make sense, despite the trustworthiness of the authors of these articles, since they did not put forward new ideas, but only the interpretation of scientific views of their schools.

K. Marks wrote that "Only at the world market the money fully functions as a commodity, the natural form of which is, at the same time, the social form of the implementation of human labor in abstracto. The way of its existence becomes adequate to its concept" [Marx K. Coll. works. V. 23. Capital. V. 1, section "World money"].

In the perestroika period, there are many words about social justice. No modern politician can miss an opportunity to say that he is committed to the principle of justice. However, as soon as it becomes necessary to more specifically solve problems related to justice, serious difficulties arise both in theoretical research and practical implementation of justice.

But we have already seen in history, what were the results of solving the issues of justice based on the theory and practice of mercantilism. Fair public relations can be implemented on the basis of **the system of measures of economic metrology, in which the central place is taken by the measure of labor, measure of consumption, measure of equitable distribution and exchange.**

In our studies of economic metrology, the significant role is played by utility on the basis of **qualimetric measuring instruments of products and measuring instruments of living and previous labor**. Through them we transit to the measure of cost and quantitative representation of the monetary measure of cost.

Our views on these problems of economic measuring instruments required multi-aspect studies of a wide range of interrelated physico-technical, chemical, biological, labor, qualimetric, economic and social measurement procedures in public life.

"In the history of the Soviet state, many attempts were made to implement a fair assessment of the labor contribution of people. For example, among them were the establishment of the labor-day, labor units (threads) by Strumilin, point system of tariffing and classifying of works, ILD, etc. They all testify to the public striving for an intuitively clear principle of fair assessment of people by their labor... No matter how ravishing are speeches about the market "automatism" of justice, however, we cannot do without legislatively established measure of labor in society. The life literally screams about it!" (Yu. Semenov).

Conclusion

For 50 years (and this is for half a century!) scientists and practical experts of the Soviet Union and the Russian Federation have been studying the anti-qualimetric practice of managing the national economy on the basis of conceptual positions of official political economy. The statistical data of national economy and gross indexes of product volume, labor productivity in monetary terms, incomes and profits, achieved without any special improvements in product quality, have caused the social necessity for a large group of specialists to form a special research team: “Cost-effective method of managing the national economy of the USSR”.

Another area united enthusiasts in scientific search for methods of quality measurement called **“qualimetry”**.

Qualimetry is a branch of science that extends the operation of metrology. Axiology produces qualimetry and metrology supplies it with measurement methodology, so, qualimetry deals not with **evaluation**, but quality **measurement**. Consequently, its methodology and applied methods refer to the exact sciences dealing with the measure used to quantify the properties of certain quality of the object.

The creation of metric system of measures in the era of French bourgeois revolution in the late XIX century was a turning point in the development of metrology. It led to the elimination of isolation and closure of national and local measures in some countries. Metrology, while it formed the International System of Units, had passed a long and difficult way of development in different countries. Now the applied scientific discipline has been formed, based on the achievements of natural, technical and social sciences, the study objects of which are natural phenomena and production systems by measuring a wide range of values and using the created methods and means of their unity and required accuracy. Theoretical, applied and legislative branches were formed in metrology.

However, the metrological system is not closed, it continues to evolve, constantly capturing in its domain the sections of economics and sociology still being beyond its measurement procedures.

The openness of metrological system is extremely important for combining economics and metrology into the single scientific area – economic metrology. In our opinion, **qualimetry**, as the science of quantitative methods of quality expression, i.e., of its measurement, serves as the link between economics and metrology.

In our investigations we proceed from the fact that the basic metric units are not "God given" and **taken** by man (mankind) from itself, and then quantified in the surrounding natural phenomena for itself. We emphasize without proof our assertion that a meter is a step of a standard human body; a kilogram is a liter ($dm^{3)}$ of water required for a standard human body for daily basic metabolism; a second is one cycle of the heart muscle contraction of a standard human body in the state of complete rest (state of basic metabolism).

If the above statements are true, then Protagoras was right, to whom the thesis "man is the measure of all things" is attributed. Nevertheless, human life can be viewed from the most diverse points of view: biological, economic, social, etc. "In the real world, there are only three kinds of "products": substance, energy and information" (V. A. Trapeznikov). The living organism can deliver the ordered substance to the external environment as the result of metabolism based on the law of mass transformation and conservation of substances.

The energy is continuously generated by the living organism, moreover, the muscular energy is very important for animals – it provides food and preserves life. The most valuable are the control effect on the external environment, which man purposefully performs, generating the necessary information for this.

We essentially consider all phenomena of nature and society as processes from the standpoint of the manifestation of three basic laws:

substance: the law of mass transformation and conservation of substances;

energy: the law of energy transformation and conservation;

information: the law of information transformation and accumulation.

Every single process of transformation is the unity and simultaneity of manifestation of the indicated laws.

The comparison of main units with the manifestations of indicated basic laws allows asserting that the metric system of units should be supplemented by the units of **information measurement** in the part of the main units and, through it, by the whole system of economic and social units in the part of sections of derived units.

Human relations in society are entangled by a monetary "octopus". "Money enchants people. Because of it, they suffer, they **work** for it. They devise the cleverest ways to get it and the cleverest ways to spend it". People try to understand the essence of money and turn to economic sciences, through which they find out that money is a multifunctional measuring tool of social relations and, in particular, a measure of cost, a means of circulation, a means of saving, a means of payment, a means of accumulation, world prices.

In 1936 the publisher of the world-famous reference-book Hutte announced that the value expressed in rubles is based on the fact that 1 ruble is equivalent to 0,7473234 grams of pure gold. But he immediately warns that in many countries (e.g., England, the United States, Sweden, etc.) the previously existing exchange of treasury and bank notes for gold was suspended, and, therefore, their value is subject to significant fluctuations, and, consequently, for such currencies it is impossible to make up tables valid for reasonable time. And the publisher concludes that the exchange value of such currencies has to be found in newspapers. And so, the gold standard disappeared from the world arena after the Great Depression of 1929-32. And, according to the authors of the famous textbook "Economics", the Commission on Gold, established by Reagan in 1981, did not recommend a return to the gold standard.

At the beginning of "perestroika", when the USSR was still convulsively thriving, a number of international organizations in the person of Furth Foundation decided to hold an international competition for the best project of converting the Soviet ruble among stable international currencies. In the contest, as evidenced by the results, an unusually large number of specialists (more than 600 bids) participated. We were also among the participants of the competition with our proposals on changing the money system based on the measure of labor. As a result of the competition, 5 prizes were awarded, we were given only the certification of commendation. The awards were handed and probably materialized by the prize-winners in their personal lives. However, it is sad that the object of convertibility itself – the Soviet ruble – disappeared from the world arena. Did the organizers of the contest expect such outcome?

The successors of the Soviet ruble became the “elder brother” – the Russian ruble with a two-headed predatory bird and fourteen “younger sovereign independent brothers” of the CIS minted birds, beasts and personalities. Has the situation with the noosphere of Earth improved in this regard? Modern circumstances and an endless series of tense situations in the world increasingly create pessimistic mood of people.

Not long ago (in 1993), Margaret Kennedy published the brochure entitled “Money without interest and inflation (How to create a means of exchange that serves everyone)”. She appeals to readers to participate in changing the world monetary system. But how can the broad masses manifest themselves in such intricate system as the modern interest monetary economy? She writes: “If we agree with the existence of public structures, which in their essence are directed against these goals, then social justice, environmental survival and public freedom are under threat”.

The historical fact described by M. Kennedy sounds very obliging. We will give it in full. In the Weimar Republic (1924-1933) after the hyperinflation of 1923, in 1924 Reichsmark was introduced, which meant a return to the gold standard. After “Black Friday” in 1929 and the economic crisis which started after that, Reichsbank was forced to return a part of its gold reserve taken in credit in the United States. As after that the circulation money supply could not be secured by gold in the required amount any more, Schacht, being at that time President of Reichsbank, began to reduce gradually the amount of money in circulation. The ensuing shortage of money led to higher interest rates, which was followed by the decrease in investment business, bankruptcy of companies, rising unemployment, and there appeared a good breeding ground for radicalism that eventually brought Hitler to power. Thus, the monetary policy became a prerequisite for the victory of Nazis.

Silvio Gesell foresaw such course of events. Already in 1918, shortly after the end of World War I when everyone was talking about peace and numerous organizations advocating peace were appearing, he wrote to the publisher of Berlin newspaper "Zeitung am Mittag" the following letter: "In spite of the fact that the nations give sacred oath to condemn war at all times, despite the call of millions: "No war!", in spite of all hopes for the better future, I have to say: **If the current monetary system saves the percentage economy, I will dare to claim today that within 25 years we will face a new, even more destructive war** (emphasized by Yu. Per). I see the course of events very clearly. The current level of technology will allow the economy to reach the highest efficiency very rapidly. Despite the severe damage during the war, there will be a rapid formation of capital and when it is in plentiful supply, the interest will be reduced. Then money will be withdrawn from circulation. It will lead to the reduction in industrial production, the streets will be full of the army of the unemployed... The discontented masses of people will reveal wild, revolutionary insights, poisonous sprouts of supernationalism will appear. No country will be able to understand the other, and it will result only in a war".

The greatest obstacle to the monetary system transformation is the fact that very few understand the problem, and even fewer know that there is a solution (but they do not want to realize it).

Deep inflation processes in transition economy clearly and tangibly demonstrate the instability of the whole monetary system and further urgent necessity to differentiate the functions of money and their units. First of all, the money currently seeks another unit distinguished from the ruble (the kopeck has already gone) as **a measure of cost.**

Some legal acts and norms (decrees, regulations, directives, decisions) appeared as a result of inflation and issued by administrative organs of various hierarchical levels during the past years amuse thinking people and impress interested ones. For example, the minimum wage. What measure is it? What social phenomena can and should it measure?

The minimum payment for the work performed (minimum wage) is set by the state bodies in the respective terms of money (rubles, dollars, marks, etc.). However, the very concept of value is something objective, physiologically vital activity of the phenomenon. Viewed in this way, the emergence of a new official means of payment for work and other services in the form of the minimum wage is very symptomatic. At that time (March, 1996), one minimum wage was 76,000 rubles a month, before that it was 39,000 rubles a month. The dynamics of the minimum wage is indicative: in 2013 – 5,205 rubles, in 2014 – 5,554 rubles, in 2015 – 5,955 rubles. Thus, the minimum wage is a kind of constant measure of living conditions and it constantly changes its ruble equivalent. So, the fixed minimum wage reflected the physiological minimum of energy consumption in the human body during the transition from “no work” (basic metabolism) to “work” (to suitable behavior of an unemployed about getting a minimum wage). Moreover, the minimum wage acts as the measure of labor product set according to their ability to replenish physiological energy losses in a human body.

Much is said about social justice in everyday life. None of the modem politicians will fail to say that he “is committed to the principle of fairness”. However, as soon as it becomes necessary to solve problems related to justice more specifically, there are serious difficulties in the theoretical study and practical implementation of justice.

When you ask the question: “Why did the Soviet Union fail to build socialism?” Instead of a clear answer another question comes up: “Was justice put right in the Soviet Union?” Justice in itself means the relationship between people with the “right to know”, i.e. on the basis of law. According to the Marxist theory it is known that “by its very nature the right can be exercised only in the application of an equal measure” and generalizes the meaning of the law-governed state that “the right of manufacturers is **proportional** to the labor they produce, ... the equality means that measurement is made by equal measure – labor, ... but for labor to serve as a measure it must be determined by duration or intensity, otherwise it would cease to be a measure” [Marx K., Engels F. V.19. P. 19].

Thus, we face a major problem – the definition of labor measure, measurement of its quantity and quality. Without solving this basic problem the meaning of law-governed state is lost, the slogan “To each according to his work” hangs in the air, justice, no matter how much we speak about it, remains a wishful thinking. But where is the key to solving the problem? It is in the same Marxist logic of **labor measure**, which can be legally implemented on the basis of metrology research of physical and informative and psychological manifestations of human labor processes. The significant part of our research published in our books is dedicated to this problem.

Politicians, economists and lawyers are trying to see justice in the quantitative monetary manipulations, both with respect to the individual and between different parts of the state and between different states. But we have already seen from the history the consequences of resolving the issues of justice on the basis of theory and practice of mercantilism. Fair social relations can be based on **the system of measures** of economic metrology where the central position is occupied by **the labor**

measure, measure of consumption, measure of fair distribution and exchange. However, there is such a comprehensive notion as **cost**, which is interpreted differently by researchers in economics. We proceed from the following definition: "Cost is the relation of production costs to utility" [Marx K., Engels F. Coll. V.1. Outlines of the criticism of political economy].

In our studies the important place is given to the utility measurement on the basis of qualimetric measures of products and measures of living and past labor. Through them we come to the cost measure **and quantification of monetary measure** of cost.

To prove our points of view on the stated problems of economic measures we needed to do multi-disciplinary research of a wide range of physical, technical, chemical, biological, labor, qualimetric, economic and social measurement procedures in public life. We presented our views as the concept of qualimetry.

Qualimetry as scientific method of measurement will bring its values, measurement units and procedures for measuring the quality of labor, products and services to the International System of Units (SI), and will save human society from the uncertainty of monetary wanderings in the darkness of the "card" game of the game rules owners. Qualimetologists will develop the harmonious system of measuring procedures for disclosing the non-monetary essence of the concept: "cost is the ratio of production expenditures to utility. If the expenditures for manufacturing two things are the same, then the utility will be the decisive factor in determining their comparative value. This basis is the only correct basis for exchange. But if we proceed from it, who will decide the thing utility? Is it easy to take into account the opinion of the participants of the exchange? Then **one** party, at least, will be deceived. Or should there be such definition that is based on the utility inherent in the thing itself – the definition independent of the parties involved and unclear for them?" Fred Engels was only 24 years old when he raised these questions. 170 years have already passed since then. But there are no answers to F. Engels' questions officially recognized in the management of national economic processes. We can only deeply regret that even in modern academic science the syndrome of "mental" running of economists-monetarists of different levels – from a company accountant to theorizing economists-academicians – is prevailing.

We are still looking for answers to the questions raised at the time of Engels, when there was no understanding even of the basics of metrology as practical unified global system of measurements. Much has been done in scientific and practical direction by the founders, enthusiasts of qualimetry. A vast field of activities is open for inquisitive young minds to find answers to Engels' questions, and, thereby, approve, in collective effort, **the qualimetric management method** in all areas of public life. We know it is not easy. We can only reassure ourselves with historical analogies. For example, Max Planck's personal experience led him to the deep generalization: "The great scientific idea is rarely implemented by gradually convincing and proselyting the opponents... In fact, it happens that the opponents are gradually passing away, and the growing generation is mastering a new idea from the beginning..." A new word "underestimated or rejected by the contemporaries, can be easily perceived as academic dogma by next generations" [Salyamon L. S. On some factors that determine the perception of a new word in science. In the book "Scientific discovery and its perception" / Ed.

S. R. Mikulinsky, M. G. Yaroshevsky. Moscow: Nauka, 1971. 309 pp. P. 97].

As can be seen, the development of quality control in the Soviet Union, the Russian Federation, CIS is not an exception. And here we have to point out with regret that Glichev Aleksandr Vladimirovich (the founder of the All-Union Institute of Standardization of the State Standard of the USSR, organizer of the Academy of Quality Problems), Siskov Vladimir Ivanovich (Deputy Director of the All-Union Research Institute Standard), Elmeev Vasily Yakovlevich (Head of the Department of Sociology of Leningrad University) – passed away, leaving their ideas and scientific works for younger generation to study and learn. V. V. Boitsov – one of the fiercest antagonists of qualimetry, our former opponent (Chairman of State Committee for Standardization of the USSR) also passed away.

The qualimetry develops despite everything, this is testified by scientific works and publications, in particular, this book “Economic metrology. Information essence of the method” offered for the attention of readers and researchers. We acknowledge with gratitude the heroic act of the engineer, colonel, Doctor of Economic Sciences, a graduate of Kuibyshev Moscow Military Engineering Academy Gary Gaikovich Azgaldov, who set forth and substantiated the basic principles of qualimetry as the science and practical methodology of its application in the management of labor processes in society. With the work “Economic metrology. Qualimetry of labor” being published we want to please the academician of the Academy of Quality Problems Gary Gaikovich and note: “The store of qualimetry is being replenished!”

The work being published begins with my letter to S. G. Strumilin:

Dear Comrade Strumilin!

After much thought, I still decided to find your address and write this letter. I am a mechanical engineer, I was involved in practical work in the machine-tractor station at two plants in Izhevsk, Komsomol and public-inventive work. Then – the party work. Now I am a student of the Higher Party School of the Central Committee of the Communist Party of the Soviet Union.

I beg you in advance, if possible, to excuse me for disturbing you. I know your elderly age and, in spite of this, your busyness.

I have been studying, am studying, and will be studying your works, because they are imbued with the deepest analytical intellect of our time. I don't know another scientist, but you, who would, after Marx, think so deeply and analyze the essence of social labor. And you are right a thousand times when you write that the problems of rational organization and rating of labor are the most important for us.

I always had to think about the questions: "What is the social labor? How to measure it?" And it seems I was able to discover the essence of the answers to these questions. Rather, the answers to these questions that are given in the work "Problems of labor economics" (published in 1957).

Here is the essence of your answers:

1. Any labor process should be considered, first of all, from the point of physiological severity and harmfulness, and specific types of labor should be grouped depending on the human energy consumption needed to overcome the severity and harmfulness of the labor process. Measurement in kilocalories per day or kilocalories per hour.

2. It is necessary to consider any process of labor, secondly, in terms of its complexity and group into the

categories of complexity that represent the intensity of human energy consumption depending on the means and objects of labor, i.e., the ratio of the functions performed by the human body in the labor process.

If we take mechanical engineering, t piece / t shift = = complexity coefficient. This is just an interpretation of your formula: $x = 0{,}8 + 0{,}2R$ [threads], where R – work category. And what will happen, Stanislav Gustavovich, if we connect, if we consider together the threads with physiological expenditure of human energy: a kcalorie a day = = 24 kcal per hour.

My ideas are stated in the tariff scale of socially necessary expenditures of labor in socialism.

Stanislav Gustavovich! I believe that among the serious scientists curtsey letters are not approved, so let me make a request. If possible, I would ask to settle down the thoughts that are overwhelming me when studying your works.

I have some manuscripts related to these thoughts.

I have to apologize again for troubling you. If allowed, I would gladly say: your student Perevoschikov Yury Semenovich.

My address: Moscow, Miusskaya sq. 6, Higher Party School of the Central Committee of the Communist Party of the Soviet Union, bld. 4.

Home phone number: 06-48-17.

January 7, 1964.

A year after the letter, I was invited to the S. G. Strumilin (Leninsky Prospect, 13), and then there was my meeting with the academician. After the 2-3-hour conversation, he handed me his written conclusion with wishes of success. Since then, exactly 50 years have passed! I'm glad to have finished the study I started then and dedicate it to Stanislav Gustavovich on his birthday on 29 January.

Many years of research in labor measurement issues were possible only through collective efforts of employees united by the common idea approved by Academician S. G. Strumilin, supported by the first rector of the university B. N. Shulga, included in R&D plans of the Ministry of Defense Industry of the USSR by Yu. D. Maslyukov.

50 years have passed from the day of my address to Academician S. G. Strumilin. On my way of scientific searches I met scientists with different views of life. Some of them reacted with anger on my search for the measure of labor, some – without understanding the essence of my research, and others – with interest for the particular arguments about “threads”. The latter ones were good “switchmen” on my research way.

Graduates of the Higher Party School of the Central Committee of the CPSU after graduation had to return to the party-political work. The letter by S. G. Strumilin helped me: the first secretary of Udmurt Regional Committee of the CPSU V. K. Marisov after the long conversation said, “Okay, deal with your science”. The Head of the Department of Labor Economics of Higher School of Labor Movement of All-Union Central Committee of Trade Unions A. S. Kudryavtsev agreed to be my scientific supervisor on the condition that the research topic had to be manufacturing. In 1970 there was the defense on the theme “Technological labor intensity and its economic importance”, and I was awarded the degree of Candidate of Economic Sciences in the field of labor economics. With deep gratitude I bear in my heart the memory of the professor of the Academy of Social Sciences, Central Committee of CPSU A. G. Grzhegorzhevsky, Doctor of Economic Sciences V. F. Mayer. Their approval of the ideas of qualimetry gave me the confidence to summon all strength and continue research, bringing to the defense the thesis for the degree of Doctor of Economic Sciences at Leningrad University in 1988. Subject of the thesis – “Measurement of labor costs and its results at the workplace (Methodological aspects of theory and practice, social and economic importance)”. At Leningrad University I found the advocates of social and political significance of qualimetric direction in sociology (V. Ya. Elmeev, Doctor of Philosophic and Economic Sciences, V. G. Dolgov, Doctor of Economic Sciences) and the need to create the special area called “Economic metrology” by A. E. Kogut.

The large article “To examine the problems of measuring labor productivity” [Zhukov L., Perevoschikov Y. // Communist. Theoretical and political journal of the Central Committee of CPSU. November 1985. № 17] was extremely important for the continuation of our researches on the application of qualimetric methods. Here, I would especially highlight that the issue was devoted to the 165th anniversary of birth and the 90th anniversary of death of Friedrich Engels. The article appeared in the journal only due to the progressivity of views of the editor-in-chief R. I. Kosolapov, Doctor of Philosophical Sciences, editor V. G. Ivanovsky, who did not take the opinion of the Head of Department E. T. Gaidar – “You can throw it into the basket”.

The monograph “Economic metrology. Qualimetry of labor” is published in the year of 195th anniversary of Friedrich Engels. Paying tribute of deep respect to his ideas and, above all, to the “brilliant sketches of criticism of political economy”, the author of the book being published is convinced: “It’s still early to remove 25 Principles of Communism, declared by Friedrich Engels in 1847, from the today’s agenda”.

The active participation of the Deputy Director of the All-Union Research Institute for Standardization of the USSR, Doctor of Economic Sciences V.I. Siskov in the development of our researches should be specifically pointed out. Following his initiative, our researches were discussed at the special section of the Scientific and Technical Council of the State Committee for Standardization of the USSR, as evidenced by its decision.

APPROVED

Deputy Chairman
State Committee for
Standardization of the USSR
N. S. Kruglov
December 21, 1990

DECISION

Section “Problems of complex analysis,
evaluation of product quality and cost-effective
mechanism of economic management” of Scientific and
Technical Council of the State Committee for Standardization
of the USSR dated November 14, 1990

Having listened and discussed the report by Yu. S. Perevoschikov, Doctor of Economic Sciences, Professor, Head of Department of Udmurt State University “Methodology of qualimetric assessment of the product quality and labor costs and proposals for the standardization of these methods”...,

RESOLVES:

1. To deem that the developed and tested out methodological documents on qualimetric approach and improvement of technical and economic analysis of mechanical engineering production correspond to the goals and

tasks of cost-efficient (labor-saving) system of socialist economic management.

2. The extensive development of investigations in the field of qualimetry and dissemination of its ideas in technical and economic activity in industry requires solving a number of problems on standardization of methods of production qualimetric analysis, and, therefore, it is deemed necessary to organize the temporary creative team under the supervision of Doctor of Economic Sciences, Professor Perevoschikov Yu. S. and request in the years 1990 – 1994 as follows:

a) to prepare terminological standards for production qualimetry coupled with their terminological standards for product quality control;

b) to develop the guiding methodological materials (GMM) for calculating qualimetric indexes of production and operation of products defining the order of their reflection in the standards of Unified System of Engineering Drawings and Unified System for Technological Documentation;

c) to develop methods of quantitative calculation of the product design complexity with the reflection of its values in the respective documents and standards of Unified System of Engineering Drawings;

d) to prepare proposals for the reflection of qualimetric indexes of production and operation of products in the charts the technical level and product quality;

e) to develop methods for calculating the demand in resources (materials, energy, labor force, equipment, production facilities) for manufacturing products at the design stage using the methods of calculating qualimetric indexes;

f) to prepare proposals for the improvement of inter-sectorial methods of calculating the production capacity of mechanical engineering enterprises and their divisions;

g) to develop methodological bases of the systems of norms and standards of technical and economic interaction between enterprises-manufacturers and enterprises-consumers;

h) to develop, based on qualimetric approach, the structure and content of automated system of planning calculations (ASPC) on the example of single products and their complexes, which allows combining CAD and CAM in the unified system.

3. To recommend Doctor of Economic Sciences, Professor Yu. S. Perevoschikov to prepare the report "Problems of fundamental restructuring of economic measurements in the national economy of the USSR".

To ask the editors of "Standards and quality" to inform the readers about the details of the discussions of the issues raised at the section of Scientific and Technical Council and to arrange the special part on the pages of the journal dedicated to the problems of metrology and qualimetry application in economy.

Chairman of the section of Scientific and Technical Council, Doctor of Economic Sciences, Professor

V. I. Siskov

The investigation results being published are, in a way, the Final Report of executing the tasks put forward 25 years ago on the theme: "Problems of complex analysis, evaluation of product quality and cost-effective mechanism of economic management".

The difficulties of the post-perestroika public life in the Russian Federation made the author feel pessimistic, and this feeling was overcome with the moral and friendly relations with Doctor of Economic Sciences V. N. Bobkov, Doctor of Economic Sciences S. S. Gubanov, Candidate of Economic

Sciences A. V. Anoshin, Candidate of Biological Sciences V. V. Orefkov, A. V. Volkov and others.

The study aid was developed with the active participation of the staff of the Institute of Economics and Management: Doctor of Economic Sciences A. M. Makarov, Candidate of Economic Sciences D. G. Maksimov, leading engineer A. V. Ashikhmin, specialist E. A. Bazhenova who has cared of the manuscript preparation for publication, employee N. A. Dyakonova, whose long-term work with the author has produced positive results.

List of certificates (*information and software patents*)

Cert. 2011619204 Russian Federation, Automated system for the qualimetric analysis of machine-building parts on the basis of CAD Compass-3D (ASKA) [program code] / Ermilov V. V., Perevoschikov Yu. S.; applicants and patent holders – Ermilov V. V., Perevoschikov Yu. S. (RU). – No. 2011617387; applied on 04.10.2011; registered on 29.11.2011, Register of Computer Software;

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